

LLRW and 11e.(2) Construction Quality Assurance/Quality Control (CQA/QC) Manual

LLRW and 11e.(2) CQA/QC Manual

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - DOCUMENT CONTROL

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
1) SCOPE: This work element applies to all construction activities in the Class A West and 11e.(2) embankments.		
2) QC DOCUMENTATION APPROVAL: QC documentation shall be approved/rejected by the QC Supervisor and submitted to Quality Assurance.	Sign the reports indicating documentation is adequate, correct, and has been accepted by QC. Provide QA with copies of the documentation and obtain their signature on the documentation indicating QA acceptance. Ensure that corrective actions required by QA personnel are accomplished.	Review the documentation generated by QC. Report deficiencies to the QC Supervisor and Quality Assurance. Verify that corrective action has been taken (where required) and recorded on the QC documentation. Countersign reports indicating documentation is adequate, correct, and has been accepted by QA. Record findings on the Daily Quality Assurance Report.
3) QC DOCUMENTATION FILES: Original QC documents shall be maintained. A copy shall be saved into the electronic database.	After the QC documentation has been accepted by QA, a copy of the original shall be saved into the electronic database.	Periodically review the electronic database to ensure the correct documentation is being saved.
4) QA DOCUMENTATION FILES: Original QA documents shall be maintained. A copy shall be saved into the electronic database.	None	

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
5) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.		
6) RUNON CONTROL DURING PROJECT: The perimeter berms shall be constructed to a minimum of three feet above the ground elevations (GL) shown in the engineering drawings. Berm material will be as specified in Specification 33. The first lift of material shall have an uncompacted thickness of no greater than 12 inches. There is no lift thickness specification for subsequent lifts. Elevations for the berms between the specified ground elevations shall be linearly interpreted between the shown elevations. The berms shall be a minimum of four feet wide at the top and shall be compacted to 90 percent of a standard Proctor.	Verify that the required berms have been constructed to the specified dimension. Record any findings on the Daily Construction Report. Conduct laboratory classification (ASTM D2487) and Standard Proctor tests (ASTM D698) at a rate of one test per 5,000 linear feet of berm, with a minimum of one test per berm. Conduct one density test per 300 linear feet of the first lift and subsequent lifts of the berm to ensure that it meets specifications. Record density tests on the Field Density Test form.	Verify that berms have been tested and inspected by QC personnel and that appropriate density test have been conducted.
7) RUNOFF CONTROL DURING PROJECT: Berms shall be constructed around the outside Perimeter of waste placement areas to a height of three feet. This height is measured as the elevation above the as-built elevation of the liner protective cover. Berms shall be a minimum of three feet wide at the top. Berm material will be as specified in Specification 33. The first lift of material shall have an uncompacted thickness of no greater than 12 inches. There is no lift thickness specification for subsequent lifts. The berm will be constructed on top of the clay liner such that the berm is not in contact with native ground. The berm shall be constructed directly on top of clay liner or liner protective cover that has been compacted to at least 90 percent of a standard Proctor. A minimum distance of 10 feet shall be maintained between the toe of the berm and the toe of the waste. The berms shall be compacted to 90 percent of a standard Proctor.	Verify that the required berms have been constructed to the specified dimension. Record any findings on the Daily Construction Report. Conduct laboratory classification (ASTM D2487) and Standard Proctor tests (ASTM D698) at a rate of one test per 5,000 linear feet of berm, with a minimum of one test per berm. Conduct one density test per 300 linear feet of the first lift and subsequent lifts of the berm to ensure that the specification is met. Record density tests on the Field Density Test form.	Verify that the berms have been tested and inspected, and inspected to the correct criteria by QC personnel. Review documentation to verify that the weekly access ramp inspections have been performed.

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<p>Contact water shall be controlled inside the runoff control berm system. Contact water is defined as any storm water that falls within the runoff berm system in the active, unfinished portions of the embankment. Access ramps that cross runoff berms shall be constructed and maintained to prevent such runoff from leaving the lined portion of the embankment.</p>	<p>Inspect the access ramps that cross runoff berms on a weekly basis for the presence of runoff control channels and document the inspection on the Daily Construction Report.</p>	
<p>Storm runoff for up to a 10-year, 24-hour event that runs off from those portions of the embankment that have been completed to final cover design shall be managed and controlled to prevent such runoff from contacting contaminated waste material in the active unfinished portions of the embankment.</p>		
<p>After the first lift of radon barrier material for an entire side slope area (i.e., from the toe of waste to the side slope breakover) has been pushed out to the design lift thickness the adjacent runoff berm for that side slope area may be removed. During placement of this first lift of radon barrier, there is no minimum offset to the runoff berm.</p>		
<p>8) MONTHLY BERM INSPECTION: The berms are to be inspected monthly. Inspect for obvious damage to berms. Ensure berm height where roads cross berms.</p>	<p>Inspect the berm on a monthly basis and document the inspection and any corrective actions taken (if required) on the Daily Construction Report. Marker posts indicating the required berm height should be placed at both sides of a road at the point where the road crosses the berm. This is to aid in identifying damage to the berm due to road traffic. Notify the Project Manager and review documentation to verify any noted damage and required repairs. After repairs are completed, re-inspect the berm. Continue this process until the berm meets specification.</p>	<p>Verify that the monthly berm inspections have been performed and properly documented. Verify proper installation of marker posts.</p>

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<p>9) BERM MAINTENANCE: The runoff and runoff berms shall be surveyed and improved, as required, by July 1 of each year.</p>	<p>Survey the berms at 100 foot intervals and key points (i.e., changes in direction of the berm). Notify the Project Manager any noted damage and required repairs. After repairs are completed, re-inspect the berm. Continue this process until the berm meets specification.</p>	<p>Verify that the berms are surveyed and improved, as required.</p>
<p>10) MOVING OR BREACHING A RUNOFF CONTROL BERM: When moving or breaching a berm, the work must be authorized by the QC Supervisor prior to commencing work. A temporary breach of a berm may be accomplished without a temporary berm, provided the work is expected to be completed and the berm replaced the same day. A temporary berm will be designed to ensure runoff is contained within the cell and approved by the Engineering Manager.</p> <p>A berm may be partially or completely breached during cover construction (e.g., one or more of the requirements in the Runoff Control During Project specification above is no longer met) as long as runoff control is maintained from potentially contaminated areas to clean areas as approved by the Engineering Manager.</p>	<p>Review the work to be performed. Document the approval to move or breach a berm on the Breach of Berm form.</p> <p>Ensure runoff control is maintained to prevent potentially contaminated liquids running into clean areas and document on the Daily Construction Report.</p>	<p>Verify that the approval to move or breach a berm has been properly documented on the Breach of Berm form.</p> <p>Review Daily Construction Reports to ensure proper documentation.</p>
<p>11) NUCLEAR DENSITY/MOISTURE GAUGE CALIBRATION: Each nuclear density gauge shall have current calibration, performed in accordance with the manufacturer's specifications, prior to use on the project.</p>	<p>Check calibration labels to ensure equipment is calibrated prior to using.</p>	
<p>12) SAMPLING LOCATIONS FOR LOTS: For sample locations chosen by random numbers, two random numbers shall be employed. The first number (X) shall be between zero and the largest</p>	<p>Generate random numbers for each lot by using a calculator or computer with a random number generator. Locate the test location within five feet of the location specified by the random numbers. If the</p>	<p>Verify that the test sample locations are being chosen by random number.</p>

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<p>east-west distance of the lot. The second number (Y) shall be between zero and the largest north-south distance of the lot. The test location will be located at X feet east and Y feet south of the north-west corner of the lot. For a linear lot (e.g. the intersection of lifts), a single random number shall be generated.</p>	<p>sample location is outside the lot, generate two new random numbers.</p>	
<p>13) TEST METHODS: All tests shall be performed in accordance with the test methods specified in Appendix B.</p>		
<p>14) QA AUDITING: EnergySolutions shall contract with an independent firm to perform an annual audit of the CQA/QC program. The auditor shall:</p> <p>A. audit at least 15 percent of the CQA\QC documentation; and</p> <p>B. observe QC procedures for field density/moisture tests, classification tests, Proctors, permeability tests, and surveying.</p>	<p>Schedule times with the QA auditor to observe the specified testing. Cooperate with QA auditor in the review of QC documentation.</p>	<p>Cooperate with QA auditor in the review of QC documentation.</p>
<p>The audits must be coordinated so that field activities are audited. Each audit shall include observations of field activities that occur while the auditor is on-site. A copy of the auditor's report shall be submitted to the DWMRC.</p>		
<p>15) TEST FAILURE PROTOCOL: Unless otherwise specified in this Manual, any failing test shall be addressed as follows:</p> <p>A. Document the failing test result in applicable QC records.</p> <p>B. Notify construction personnel of the failing</p>	<p>Document all failing tests and corrective actions for those failures. When applicable, obtain documentation of DWMRC notification.</p>	<p>Ensure documentation is present for all failed tests. Review documentation and corrective actions. Notify DWMRC as required. Provide QC with documentation of the DWMRC notification.</p>

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<p>test result and re-work as needed.</p> <p>C. After re-work is complete, re-test and document results.</p> <p>D. If the re-test results pass, approve the work.</p> <p>E. If the re-test results fail, require further re-work until passing results are achieved.</p> <p>F. Any circumstance where re-work is not desired or possible shall be documented on a Nonconformance Report (NCR). Any circumstance addressed via NCR in accordance with this specification requires DWMRC notification and written approval prior to proceeding.</p>		
<p>16) QUALITY OF ROCK: Applies to the following cover materials.</p> <p>11e.(2): Filter Zone, Top Rock and Side Rock.</p> <p>Class A West: Type A Filter Zone Rock, Type B Filter Zone Rock, Type A Rip Rap and Type B Rip Rap.</p> <p>The rock shall have a "Rock Quality" score of at least 50 based on the following tests: Specific Gravity (ASTM C128), Absorption (ASTM C127), Sodium Soundness (ASTM C88), and L.A. Abrasion (ASTM C131 or ASTM C535). The procedures for scoring "Rock Quality" are found in Appendix C</p>	<p>As described in NUREG-1623, appendix F, perform at least one petrographic examination for each rock source in accordance with ASTM C295. If a combination of limestone, sandstone, and igneous rock is found for a source, percentages of each type of material shall be determined for scoring.</p> <p>Perform Na soundness, LA abrasion, absorption, and specific gravity testing at a rate of one set of tests per 10,000 cubic yards of rock with a minimum of four tests per embankment. Samples may be collected at the source location or from onsite stockpiles. Record the location of all collected samples in the Sampling Log.</p>	<p>Verify the frequency of laboratory quality control tests and compliance of test results.</p>
<p>17) QC PROCEDURES: Quality Control procedures to perform the actions described in this Manual are</p>		

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designated CL-QC-PR and maintained by document control. Other QC procedures are described in designated ASTM tests.

- 18) PRE-CONSTRUCTION DOCUMENTATION & COMMUNICATION:** Prior to each construction phase, and at the beginning of each construction season for ongoing phases, construction personnel will review construction phase-specific drawings, specifications, and procedures. A pre-construction meeting will also discuss key personnel and requirements for the construction phase. The construction phase-specific drawings shall be submitted to the Division of Waste Management and Radiation Control (DWMRC) prior to construction.

As waste placement is ongoing, this pre-construction documentation & communication section is not applicable to waste placement. Waste placement will be completed in accordance with this Manual and approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005.

- 19) PROJECT MANAGER:** The Project Manager shall be designated at the beginning of each construction phase. If not designated or not available, the Engineering Manager shall assume the role of the Project Manager.
- 20) NATIVE MATERIAL:** Natural soil from areas surrounding the Clive Facility. Native material may be used as fill during waste placement or in the construction of liner and cover provided the material meets project specific specifications.

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>21) OFF-SITE FILL/BACKFILL MATERIAL: Fill or backfill material may consist of licensed waste, native material, or other materials from off-site sources.</p> <p>Fill or backfill material from off-site sources shall conform to the following requirements:</p> <p>A. It shall consist of only natural soil and rock.</p> <p>B. It shall not exceed the Exempt limit of UAC R313-19-13(2)(a)(i)(B).</p> <p>C. It shall not contain any of the following:</p> <ol style="list-style-type: none"> 1. Biodegradable materials. 2. Hazardous waste, including but not limited to listed or characteristic waste. 3. Material regulated by any other State or Federal regulatory program. <p>D. It shall only be used in the waste portions of the Class A West or Mixed Waste embankments.</p> <p>E. The following records shall be maintained:</p> <ol style="list-style-type: none"> 1. The identity / location of the source(s) of the material. 2. The volume and weight of the material. 3. Documentation that the material meets the prohibitions of Specification 21.C. <p>22) DWMRC EXEMPTION: Any requirement within this Manual may be exempted by the Director of the Division of Waste Management and Radiation Control (DWMRC). Exemptions will be confirmed in writing.</p>		

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
23) DWMRC NOTIFICATION: All DWMRC notifications within this Manual shall include a copy to the DWMRC Section Manager. Unless otherwise stated in the specification all notifications will be in the form of a letter.		

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WORK ELEMENT - FOUNDATION PREPARATION

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>24) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.</p>		
<p>25) CLEARING AND GRUBBING: Remove vegetation, debris, organic, or deleterious material from areas to be excavated for construction of cells. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.</p>	<p>Inspect the area once clearing and grubbing has been completed. Record observations and corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify and document that the clearing and grubbing has been inspected by QC.</p>
<p>26) EXCAVATION: Excavation shall be made to the lines, grades, and dimensions prescribed in the approved construction phase-specific drawings. Any over excavation shall be backfilled with native materials and compacted to 95 percent of Standard Proctor. The uncompacted lift thickness shall not exceed nine inches.</p>	<p>Observe the cell excavation. Record observations and corrective actions taken (where required) on the Daily Construction Report.</p> <p>In areas of over excavation, conduct in-place density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as a maximum of 10,000 square feet of a lift of a specified type of material. Test locations shall be chosen on the basis of random numbers (described in Specification 12).</p> <p>a. Approve lots which meet the specified compaction. b. Rework and retest lots not meeting the specified compaction.</p> <p>Proctors shall be performed at a rate of one test per 100,000 square feet for each material type. At least one proctor shall be performed for each material type. Record the location of the sample on the Sampling Log.</p>	<p>Observe QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed correctly.</p>
<p>27) SCARIFICATION AND COMPACTION: The foundation shall consist of either:</p> <p>A. For in-situ sands: Inspect the surface for</p>	<p>Inspect and verify the foundation meets the compaction specifications. Record observations and corrective actions on the Daily QC Report.</p> <p>Conduct in-place density tests at a rate of one test per</p>	<p>Observe QC personnel to ensure that the tests and observations are being performed correctly. Verify that the tests are being performed at the correct frequency and that the documentation is being completed correctly.</p>

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cracks. If cracking of the surface is observed, then scarify the in-situ sands and compact to at least 95 percent of a Standard Proctor. If no cracking is observed, then scarification is not necessary prior to compacting to at least 95 percent of a Standard Proctor.	lot and record the results on the Field Density Test form. A lot is defined as a maximum of 10,000 square feet of a lift of a specified type of material. Test locations shall be chosen on the basis of random numbers (described in Specification 12).	
B. For in-situ non-sandy soil: Scarify the in-situ soils to at least six inches and compact it to at least 95 percent of a Standard Proctor.	Proctors shall be performed at a rate of one test per 100,000 square feet for each material type. At least one proctor shall be performed for each material type. Record the location of the sample on the Sampling Log.	
28) FINAL GRADING: The foundation surface shall be smooth-drum rolled prior to clay liner placement. The foundation shall be free from surface debris, soft (wet) spots greater than three inches deep, and loose soil areas with a loose surface greater than three inches deep. Foundation shall be at or below design elevation.	Survey the foundation on a 50 foot grid and at key points (i.e. embankment break lines). Final survey measurements will be documented and provided to the QC Supervisor and Quality Assurance.	Review the final survey data. Verify the frequency of the survey points.
29) UNSUITABLE MATERIAL: Remove unsuitable material as required. Unsuitable material is non-soil material or soil which cannot be reworked to meet the compaction criteria.	Define areas of unsuitable material and notify the Project Manager that such areas must be removed. Observe the areas once the unsuitable material has been removed. Report corrective actions (where required) on the Daily Construction Report.	Verify that the removal of unsuitable material has been properly documented.
30) FOUNDATION APPROVAL: Foundation shall be approved by the Engineering Manager. Prior to covering, the Engineering Manager shall prepare a "Notice of Acceptance" indicating that the foundation meets the required specifications.	Accompany the Engineering Manager on a walk-through of the foundation area. Obtain the Notice of Acceptance from the Engineering Manager (or designee) before construction of the clay liner begins.	Confirm that QC has obtained the Notice of Acceptance.

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WORK ELEMENT - CLAY LINER BORROW MATERIAL

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
31) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.		
32) CLEARING AND GRUBBING: Remove vegetation, debris, organic, or deleterious material from areas to be used for borrow. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.	Inspect the area once clearing and grubbing has been completed. Record observations and corrective actions (where required) on the Daily Construction Report.	Verify that the clearing and grubbing has been inspected and recorded by QC.
33) MATERIAL: Satisfactory material shall be defined as CL or ML soils based on the Unified Soil Classification with at least 85 percent passing the No. 200 sieve (silt and clay), a plasticity index (PI) between 10 and 25, and a liquid limit (LL) between 30 and 50.	Perform laboratory classification tests (ASTM D 2487) at a rate of one test per lot prior to use of material in the clay liner. A lot is defined as a maximum of 5,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the Sampling Log. a. Approve lots (which meet the specified classification) for use in the clay liner. b. Lots not meeting the specified classification cannot be used.	Verify the frequency of laboratory tests and compliance of test results.
34) PROTECTION: The clay borrow material shall be handled in such a manner as to prevent contamination with radioactive waste material or other deleterious material. Acceptable clay borrow material may contain up to five percent additional rocks (less than or equal to one inch) and sand above the content found in the classification test.	Visually check clay liner materials for contamination by foreign materials. If any foreign materials are identified, the percentage of foreign material shall either be estimated in accordance with ASTM D2488 or calculated in accordance with ASTM D2487. Document findings on the Daily Construction Report. Notify the Project Manager to have operations remove or rework clays which have been contaminated above the specified requirements. Re-inspect the clay liner and document corrective actions (where required) on the Daily Construction Report.	Verify that the clay liner material is being inspected for contaminants and that the inspection and corrective actions (if required) are properly documented.

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WORK ELEMENT - CLAY LINER BORROW MATERIAL

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>35) PROCESSING: These procedures may be used to provide suitable material for construction of the clay liner.</p> <p>A. If used, apply deflocculant at a rate determined by the Engineering Manager (based on test pad data). If used, the choice of deflocculant and the application rate shall be verified in the Clay Liner Test Pad.</p> <p>B. Mix the deflocculant thoroughly into the soils by tilling or similar action.</p>	<p>Measure the mixing areas and verify that the application rate of the deflocculant is equal to or greater than the rate determined by the Engineering Manager. Record the size of the mixing areas and the amount of deflocculant applied on the Embankment Construction Lift Approval Form.</p> <p>Observe the mixed clay and notify the Project Manager of areas which are not adequately mixed. Re-inspect after corrected. Document observations and corrective actions, if required, on the Daily Construction Report.</p>	<p>Verify that the size of the mixing areas and the amount of deflocculant applied has been properly documented.</p> <p>Verify that the clay is being inspected correctly and the inspection documented.</p>

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WORK ELEMENT - CLAY LINER TEST PAD

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>36) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.</p>		
<p>37) NOTICE OF TEST PAD CONSTRUCTION: The clay liner test pad plan shall be approved by the DWMRC. The clay liner test pad plan shall be provided to the DWMRC at least 14 calendar days prior to test pad construction. If DWMRC has not provided approval or deficiency notification prior to the end of 14 calendar days, construction may proceed as proposed in the test pad plan.</p>	<p>Obtain documentation confirming that the test pad plan has been approved by the DWMRC or the 14 calendar day period has ended.</p>	<p>Verify that the test pad has been provided to the DWMRC at least 14 calendar days prior to construction of the test pad. Provide QC with documentation of DWMRC approval or documentation that the 14 calendar day period has expired.</p>
<p>The DWMRC shall be notified 48 hours in advance of the start-up of test pad construction.</p>	<p>Obtain documentation confirming that the DWMRC has been notified, as required.</p>	<p>Notify the DWMRC 48 hours in advance of the start-up of test pad construction. Provide QC with documentation of DWMRC notification.</p>
<p>38) TEST PAD(S): A test pad with minimum dimensions of 60 feet by 75 feet will be constructed using the procedure proposed for construction of the clay liner.</p>	<p>Observe the construction of test pads. Measure each test pad to ensure that it is constructed to at least the size required. Record the test pad size on the Embankment Construction Lift Approval Form.</p>	<p>Observe the construction of the test pads. Verify that the test pad has been measured and is properly documented.</p>
<p>Prior to use of manually operated compaction equipment, a small test pad with minimum dimensions of five feet by five feet (sized appropriately for the equipment used) will be constructed. The purpose of this small test pad is to establish equipment and procedures for construction of clay liner in locations where large equipment is not practical (e.g. repairs). If manually operated compaction equipment is not used on the project, a small test pad is not required.</p>	<p>The large test pad shall be divided into three lots per lift (approximately 1,500 square feet per lot). Each lift of the small test pad shall equal a lot.</p>	
<p>A new clay liner test pad shall be constructed each time there is a change in specifications, construction procedures, unified soil classification, or types of equipment.</p>		

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WORK ELEMENT - CLAY LINER TEST PAD

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
Clay liner test pads are to be constructed and tested in accordance with the following specifications:		
A. Prior to compaction, conduct at least one classification and gradation test for each test pad.	Conduct classification and gradation tests (as described in Appendix B) at a rate of one of each type of test per test pad.	Verify the frequency of tests and compliance of test results.
B. Place the clay in at least three lifts with the first lift uncompacted thickness not exceeding twelve inches. Remaining lifts shall have a loose material thickness not exceeding nine inches for each lift.	Measure the lift thickness at a rate of one test per lot. Record thicknesses on the Embankment Construction Lift Approval Form.	Verify that the number of lifts and lift thicknesses has been documented. Verify that the clod size inspection has been performed and documented for each uncompacted lift thickness.
C. The clay material will have a dry clod size less than or equal to one inch.	Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one inch. Notify the Project Manager to have operations remove clods greater than one inch. Record inspection of the clod size on the Embankment Construction Lift Approval Form and re-inspect the uncompacted lift if necessary. Record any corrective actions performed on the Daily Construction Report.	Verify that the dry clod size inspection has been performed and documented, including corrective actions as necessary.
D. The clay is to be placed and compacted by equipment proposed for use during construction of the clay liner.	Record type of equipment used, and number of passes on the Embankment Construction Lift Approval Form.	Perform a minimum of one visual inspection per test pad.
E. The lifts of clay shall be bonded by providing a rough upper surface on the underlying layer of clay liner. The surface should have changes in grade of approximately one inch or more at a rate of two or more per linear foot.	Perform a visual inspection to verify that there are adequate changes in grade. Any areas of concern shall be verified by placing a straight edge at least two feet long on the surface and counting the number of points approximately one inch or more below the straight	Verify the frequency of measurements and compliance of test results.

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WORK ELEMENT - CLAY LINER TEST PAD

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
	edge. Notify the Project Manager of any deficiencies. Re-inspect after the Project Manager has corrected deficiencies.	
F. The clay is to be compacted to at least 95 percent of a standard Proctor with moisture content between one-half a percentage point below optimum and five percentage points over optimum. Compaction of the large test pad is to be accomplished by at least four passes of suitable compaction equipment.	Conduct in-place moisture-density tests at a rate of one test per lot, with a minimum of three tests per lift for large test pads and one test per lift on small test pads. The test location shall be chosen on the basis of random numbers (described in Specification 12). Record the test result on the Field Density Test form. a. Approve lots which meet the specified moisture and compaction. b. Notify the Project Manager of lots not meeting the specified permeability to have the areas reworked. c. Retest (moisture/density and permeability) lots after rework has been completed. d. Any additional work under b. shall be included in the test pad construction method.	Verify the frequency of tests and compliance of test results.
G. The clay is to be constructed to provide a permeability less than or equal to 1×10^{-6} cm/sec. Permeability testing on the bottom lift will be performed at the surface. Permeability testing on the second lift will be performed greater than or equal to two inches below the surface. Permeability testing on the third lift will be performed greater than or equal to four inches below the surface.	Conduct in-place permeability tests at a rate of one test per lot per lift. The permeability test shall be run within five feet of the moisture-density test (see Appendix B). Record the test result on the Field Permeability Test form. a. Approve lots which meet the specified permeability. b. Notify the Project Manager of lots not meeting the specified permeability to have the areas reworked. c. Retest (moisture/density and permeability) lots after rework has been completed. d. Any additional work under b. shall be included in the test pad certification report.	Verify the frequency of tests and compliance of test results.
H. The procedures used to construct the test pad shall be reviewed and approved by a Utah licensed Professional Engineer.	Provide the Utah licensed Professional Engineer with copies of the documentation for the test pad for review and approval.	Verify that proper approval has been obtained for the test pad and that the necessary construction procedure documents are in place for use during clay liner construction.

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I. The test pad certification report shall be approved by the DWMRC prior to using the new test pad construction method. However, if the DWMRC has not provided approval or deficiency notification prior to the end of 14 calendar days from the time the certification report was submitted, construction may proceed using the new construction method.	Obtain documentation confirming that the test pad certification report has been approved by the DWMRC or the 14 calendar day period has ended.	Verify that the test pad certification report has been provided to the DWMRC. Provide QC with documentation of DWMRC approval or documentation that the 14 calendar day period has expired.

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WORK ELEMENT - CLAY LINER PLACEMENT

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>39) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.</p>		
<p>40) LIFT IDENTIFICATION: Each lift shall be given a unique lift identification number for testing and surveying purposes.</p>	<p>Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift.</p>	<p>Verify that a lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paper work for that lift.</p>
<p>41) PLACEMENT: The clay liner will be prepared, placed, and compacted using the same type of equipment and mixing and compacting procedures that were approved in the test pad.</p>	<p>Observe the clay liner placement. Record the equipment used to place the clay liner and any corrective actions (where required) on the Embankment Construction Lift Approval Form.</p>	<p>Verify the equipment used to construct the clay liner has been documented and that it is the same type of equipment used to construct the test pad.</p>
<p>42) LIFT BONDING: The lifts of clay shall be bonded by providing a rough upper surface on the underlying lift. The surface should have changes in grade of approximately one inch or more at a rate of two or more per linear foot.</p>	<p>Perform a visual inspection to verify that there are adequate changes in grade. Any areas of concern shall be verified by placing a straight edge at least two feet long on the surface and counting the number of points approximately one inch or more below the straight edge. Notify the Project Manager of any deficiencies. Re-inspect the surface after corrective actions have been completed. Document any deficiencies and corrective actions taken on the Daily Construction Report.</p>	<p>Verify the frequency of measurements and compliance of test results.</p>
<p>43) LIFT THICKNESS: The first lift of material shall have an uncompacted thickness of no greater than 12 inches. For the remaining lifts, the loose lift thickness shall not exceed the lesser of the lift thickness used to construct the test pad or nine inches.</p> <p>A. Thickness for the lift will be established by installing grade poles on at least a 70-foot grid and at all control points. The grade poles must not be installed deeper than one inch into the underlying clay liner. The grade poles must be marked at the appropriate depth to establish the grade. After the grade for the lift has been</p>	<p>Verify that the required grading tolerance is achieved as follows:</p> <ol style="list-style-type: none"> Ensure that the required frequency for placement of grade poles has been met. Compare soil level with the marked level on the grade poles. Visually check between poles for high or low spots. Define high out of specification areas and notify the Project Manager to rework those areas. Re-inspect areas reworked and approve areas meeting criteria. Continue "b" through "d" above until all areas meet criteria. 	<p>Observe QC personnel every lift to ensure that the measurements are being performed correctly. Verify that the measurements are being performed at the correct frequency and that the documentation is being completed. Verify that the clod size inspection has been performed and documented for each uncompacted lift thickness.</p>

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checked and approved by QC personnel, the grade poles shall be removed.	g. Indicate areas meeting criteria on the Embankment Construction Lift Approval Form.	
- OR -	- OR -	
B. Survey to determine lift thickness using the same grid spacing described in Specification 43.A. Survey equipment shall have a tolerance no more than ± 0.1 foot.	a. Verify survey equipment is within a tolerance of ± 0.1 foot. b. Verify correct set-up and operation of equipment. c. Visually check between survey points for high or low spots. d. Define high out of specification areas and notify the Project Manager to rework those areas. e. Document survey results on a survey report.	
The clay material shall have a dry clod size less than or equal to one inch.	Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one inch. Notify the Project Manager to have operations remove clods greater than one inch. Record inspection of the clod size on the Embankment Construction Lift Approval Form. Re-inspect and record any corrective actions performed on the Daily Construction Report.	
44) KEYING-IN: Segments of cell clay liner constructed at times more than 30 days apart from each other shall be keyed-in to each other by one of the following two methods:	Verify that the new liner has been properly keyed-in to the existing liner. Record deficiencies on the Embankment Construction Lift Approval Form.	Verify that the keying-in of the liner has been documented.
A. Key-in vertical steps no greater than nine inches and at least twice as wide as they are high.		
- OR -		
B. sloping the full thickness of old liner at a maximum slope of 5:1.		

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The surface shall be maintained in accordance with Specification 47.		
45) COMPACTION: Clay liner material will be compacted to at least 95 percent of standard Proctor with moisture content between one-half of a percentage point below and five percentage points over optimum.	<p>Conduct in-place moisture-density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 1,000 cubic yards (compacted) of a single lift. The test location shall be chosen on the basis of random numbers (described in Specification 12) and documented on the Lift Approval Form.</p> <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 5,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the Sampling Log. Document results of the proctor on the Proctor Form.</p>	Visually observe at least one in-place moisture-density test per project area. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.
46) PERMEABILITY: Clay liner will have an in-place permeability less than or equal to 1×10^{-6} cm/sec.	<p>Conduct in-place permeability tests at a rate of one test per lot and record the results on the Field Permeability Test form. A lot is defined as 2,000 cubic yards of compacted clay liner. The permeability test shall be run within five linear feet of a moisture density test location.</p> <ol style="list-style-type: none"> Approve lots which meet the specified permeability. Notify the Project Manager of lots not meeting the specified permeability to have the areas reworked. Retest (moisture/density and permeability) lots after rework has been completed. Restore all test areas to assure no leaks. 	Visually observe at least one in-place permeability test per project area. Verify that the tests are being performed at the correct frequency and that the documentation is being completed. Visually observe 1 lift being compacted per phase of construction every calendar year per construction season.
47) LINER DRYING PREVENTION: To prevent the clay liner from drying, water will be applied to the clay surface on an as needed basis or the liner will be covered with nine inches of loose clay or	Observe the liner surface for drying. Notify the Project Manager and notify QA of any desiccation cracks larger than one-fourth inches wide and three-inches deep in the clay liner. Retest reworked/repared areas in	Verify that the liner is being inspected correctly and the inspection documented. Report discrepancies to the DWMRC as required.

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<p>six inches of compacted clay. Newly constructed liner will be covered within 15 days of liner completion. Desiccation cracks larger than one-fourth inch wide and three-inches deep in the clay liner will be reported to the DWMRC and will be documented as a non-conformance item when discovered.</p>	<p>accordance with Specification 45. Record corrective actions taken (where required) on the Daily Construction Report.</p>	
<p>48) SNOW REMOVAL: When clay liner material is to be placed and the work area is covered with snow, the snow must be removed.</p>	<p>Observe that snow is removed. Inspect the clay liner for damage. Notify the Project Manager of any deficiencies/damage and re-inspect areas after repairs are completed. Record these corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify that snow removal is being documented and the clay liner has been inspected.</p>
<p>49) COLD WEATHER PLACEMENT OF CLAY LINER: For purposes of this Manual, “frozen” is defined as a soil temperature of less than or equal to 27°F. Clay liner shall not be placed above frozen material. In addition, no frozen material shall be processed or placed.</p>	<p>As needed, observe the area where clay liner is to be placed. If frozen material is observed, cease placement of clay liner. If frozen material is suspected, measure soil temperature. Document the stopping of placement in the Daily Construction Report.</p>	<p>Verify that clay liner is tested as required (and the testing documented) during cold weather conditions.</p>
<p>If the air temperature has dropped below 32°F since the last lift of clay liner was approved, one of the following three scenarios apply:</p> <p>A. If less than 30 days have passed since the date of lift approval and the last lift of clay liner has been covered since the approval date with at least nine inches of loose clay or six inches of compacted clay, then the cover clay may be worked with no additional testing of the lower approved lift.</p> <p>B. If less than 30 days have passed since the date of lift approval and the last lift of clay liner has not been covered with at least nine inches of loose clay or six inches of compacted clay,</p>	<p>Review ambient air temperature records as measured at the site meteorological station. Document status of clay liner cover placement on the Daily Construction Report. Measure the liner/foundation temperature when triggered under B.2. of this specification, at the specified frequency. Clay temperature shall be measured between 6:00 AM and 8:00 AM on the day that clay liner will be placed. Temperature measurements shall include a location that is most likely to be coldest; i.e., if there is a portion of the liner that is shaded or at a low point. To ensure a stable reading, the temperature probe shall be left in place for at least two minutes prior to taking the reading.</p> <p>If the initial clay temperature measurement is less than or equal to 27°F, the affected area may be resampled</p>	

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<p>then:</p> <ol style="list-style-type: none"> 1. Perform spring start-up testing as discussed below; or 2. Measure the liner/foundation temperature approximately one inch beneath the surface at a frequency of one measurement per lot (defined as no more than 100,000 square feet). If the temperature one inch beneath the surface is greater than 27°F, re-roll the surface with one pass of the same type of construction equipment (i.e., a compactor for intermediate lifts or a smooth drum roller for the final surface) and continue with liner construction. If the temperature 1 inch beneath the surface is less than or equal to 27°F, re-work and re-test density and permeability of the affected area after the clay temperature has risen above 27°F. <p>C. If more than 30 days have passed since the date of lift approval, perform spring start-up testing.</p>	<p>before 8:30 AM the same day as follows:</p> <ol style="list-style-type: none"> a. Measure the liner/foundation temperature at a frequency of one measurement per lot (defined as no more than 10,000 square feet). b. Lots where the temperature is greater than 27°F do not require rework; except that the lot where the initial temperature less than or equal to 27°F was measured shall be reworked regardless of resampling results. 	
<p>50) SPRING START-UP: See Specification 49 for situations that trigger this specification.</p>		
<p>For spring start-up testing, the surface lift is treated as protective cover, regardless of whether it was an approved lift of clay liner at one time or not. Excavate nine inches below the clay surface and re-test for density and permeability. Excavation for testing purposes may consist of removing the protective cover lift; or may be</p>	<p>Perform density and Permeability testing at the frequencies outlined for liner construction above. This testing may be performed outside of the approved lift area so long as the area tested is representative of the clay in the approved lift area (i.e., was constructed at the same time and with the same method). Moisture testing is not required for spring start-up.</p>	

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performed by ‘potholing’ only at the testing locations. Areas that have been ‘potholed’ for permeability testing shall be repaired by applying the same level of effort as prescribed by the approved test pad for liner construction.	<p>a. Approve lots that meet specification. The protective cover lift may then be worked in place and tested to become the next lift of clay liner.</p> <p>b. For lots that do not meet specification, test the surface at successively deeper nine inch increments until a passing lift is found; remove all failing lot; re-work all failing lot; and re-test.</p> <p>Document that repairs are completed to the same level of effort as required by the approved test pad for clay liner construction.</p>	
Spring start-up testing shall be conducted on 11e.(2) embankment lift areas S-11, R-12, L-12, H-12, and D-12 prior to and in the same calendar year as initial waste placement for each area.	Perform spring start-up testing prior to initial waste placement on 11e.(2) Embankment lift areas S-11, R-12, L-12, H-12, and D-12.	Verify spring start-up testing has been completed prior to initial waste placement on 11e.(2) Embankment lift areas S-11, R-12, L-12, H-12, and D-12.
51) CONTAMINATION OF CLAY LINER: The clay liner material shall not become contaminated with radioactive soils or debris during construction. The in-place clay liner material may contain up to five percent additional rocks and sand above the content found in the classification test.	Prior to compaction, visually check the clay liner material for contamination by foreign materials in accordance with ASTM D2488. Remove or rework clay liner material that has been contaminated above the specified requirements. Document corrective actions (when required) on the Daily Construction Report.	Verify that the clay liner is being inspected for contaminants and that the inspection and corrective actions (if required) are properly documented.
52) FINAL GRADING: Final grading shall be at or above design elevations.	Survey on a 50 foot grid and at key points (i.e., embankment break lines). Final survey measurements will be documented and provided to the QC Supervisor and Quality Assurance.	Review the final survey data. Verify the frequency of the survey points.
53) HEAVY EQUIPMENT ON CLAY LINER: Heavy equipment travel will be minimized on top of the finished clay liner. Heavy equipment will not be operated on saturated clay liner.	Observe work on clay liner. Notify the Project Manager of problems with equipment on the clay liner. Re-inspect problem areas once corrected. Record corrective actions taken (where required) on the Daily Construction Report.	Verify that the work is being inspected.
54) DWMRC APPROVAL: The DWMRC shall	Notify Quality Assurance that the clay liner is prepared	Provide written approval of the clay liner prior to the

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<p>approve documentation associated with completed clay liner. Documentation shall include all QC and QA records associated with clay liner construction, as well as photographs of the completed liner surface. In addition, 48 hour notification shall be provided to the DWMRC prior to placement of soil material over the clay liner (waste or soil protective cover). However, DWMRC approval of clay liner documentation is not required prior to placement of waste over the clay liner.</p> <p>55) LINER PROTECTIVE COVER: At least one foot of compacted native soils, free of debris, shall be constructed on top of the clay liner. This layer is termed "Liner Protective Cover". Liner Protective Cover shall be placed in accordance with the lift thickness and compaction requirements of Specifications 43 and 45 or Specifications 74 and 75. Contaminated equipment may be used to place Liner Protective Cover.</p>	<p>and ready for inspection by the DWMRC. Obtain written authorization on the Liner Inspection Form from Quality Assurance that the clay liner has been inspected. Obtain documentation of DWMRC notification from Quality Assurance.</p> <p>Verify and test Liner Protective Cover in accordance with the specifications for the relevant Work Element (Specifications 43 and 45 for Clay Liner Placement or Specifications 74 and 75 for Waste Placement).</p>	<p>placement of material over clay liner (waste or soil protective cover). Notify the DWMRC that the clay liner is prepared and ready for inspection at least 48 hours prior to covering with soil protective cover material. Provide QC with documentation of notification.</p>

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56) SCOPE: This work element applies to the Class A West, 11e.(2), and Mixed Waste embankments.		
57) APPLICABILITY: This work element is applicable to waste placed with the CAT 826 compactor.	Document equipment used for compaction on the Lift Approval Form.	
58) DEFINITIONS:		
<u>Machine Pass</u> is defined as movement of the compactor across an area of the lift in any direction, which also meets compaction criteria calculated by an algorithm in the compactor's system. For example, movement of the compactor from south to north across the lift, which also meets compaction criteria calculated by an algorithm in the compactor's system, constitutes one machine pass; the return trip from north to south, which also meets compaction criteria calculated by an algorithm in the compactor's system, constitutes a second pass.		
<u>Wheel Pass</u> is defined as movement of any of the compactor's drums across an area of the lift, which also meets compaction criteria calculated by an algorithm in the compactor's system. Since there are forward and rear drums on the CAT 826 compactor, each machine pass constitutes two wheel passes. The CAES compaction tracking system reports wheel passes.		
59) LINER PROTECTION: The compactor shall not be operated on the surface of finished clay liner or on the surface of the Liner Protective Cover directly over the clay liner. When operating on a slope that terminates on the surface of the Liner Protective Cover, the compactor shall be operated	When disposal and compaction is being performed on or adjacent to the first lift above the Liner Protective Cover, observe compactor operation for protection of the liner and Liner Protective Cover. Document observations, failures, and any corrective actions on the Daily Construction Report.	

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in a manner to prevent impact to the Liner Protective Cover. When compacting near the toe of the slope, the compactor will be operated parallel to the toe of the slope.		
60) LIFT IDENTIFICATION: Each lift shall be given a unique lift identification number.	Assign a lift identification number to each lift. Use the lift identification number to identify all paperwork for that lift.	Verify that a unique lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paperwork for that lift.
61) LIFT ACCEPTANCE: At the time of acceptance, the date and time of lift approval shall be recorded.	Record the date and time of lift approval on the Lift Approval Form.	Verify that the date and time of lift approval is recorded on the Lift Approval Form.
No waste material will be disposed on a lift until the prior lift is approved, except for stored waste described in Specifications 94 and 95.	Verify that the previous waste lift has been approved prior to waste disposal.	
62) LIFT THICKNESS: The waste material will be placed in lifts with a compacted average thickness not exceeding 24 inches.	<p>Survey the mean elevation of the top of each lift by surveying at least five points over a 10,000 square foot area. Where practical, survey the corners and at least one spot in the middle. If the average thickness of these surveys exceeds 24 inches, notify the Project Manager. The lift shall be re-surveyed with at least five more points per 10,000 square feet after it is reworked. Survey measurements will be documented on a survey report and forwarded to Quality Assurance. Lift thickness may also be verified via GPS.</p> <ol style="list-style-type: none"> Approve lifts with an average less than or equal to the specified lift thickness. Remove excess material from the thicker areas of the lift if the average lift thickness is greater than 24 inches, and re-compact lift in the areas where wastes are removed. 	<p>Perform a monthly assessment of the survey documentation performed by the QC personnel to ensure that the measurements and observations are being performed correctly. Verify that the surveys are being performed at the correct frequency and that the documentation is being completed.</p> <p>Verify that the survey data has been received from the QC personnel.</p>

- OR -

Download the CAES system report of beginning and

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<p>63) LIFT AREA: Identify the dimensions and the location of the northwest corner of the lift. There is no minimum lift area for this work element.</p> <p>64) CLASSIFICATIONS: Soil classification testing is not required for waste placed using this work element.</p> <p>65) TERRACING OF LIFTS: Lifts constructed at times more than 30 days apart from each other shall have at least one foot, measured horizontally, removed from the outer edge of the old lift (except for CLSM lifts). For compaction adjacent to CLSM surfaces, lift compaction will be conducted as close to the CLSM as the compactor can achieve.</p> <p>66) COMPACTION WITH CAES: When using the CAES system, each lift and lift interface shall be compacted by at least four machine passes with the CAT 826 compactor. The lift surface shall be firm and unyielding to the compactor's weight. A minimum of 90 percent of the grid points reported for the lift by CAES shall exhibit adequate compaction and machine passes. Adequate compaction as well as meeting the minimum</p>	<p>ending lift elevations. For lifts that are not sloped, survey data may be used for beginning lift elevation. Lift thickness shall be reported using CAES in accordance with current operating procedure. When calculating the average lift thickness on a side slope, no point shall be more than 2.1 feet. If CAES is used to document lift thickness on the side slope, there shall be no white pixels shown in the lift. CAES data may be supplemented by GPS for areas where compactor coverage is inconclusive.</p> <p>Locate the northwest corner of each lift, and document the location and lift dimensions.</p> <p>Inspect the intersections of old and new lifts. Verify that the outer one foot of the old lifts are being removed (except for CLSM lifts). Record any problems and corrective actions taken on the Daily Construction Report.</p> <p>Document the CAES system report of compaction for each lift area. Compactive effort is reported by CAES on a roughly 3.3' x 3.3' grid; with each on-screen pixel representing one square meter. Ensure that the CAES reports a minimum of four machine passes (i.e., 8 wheel passes) for at least 90 percent of the grid points in the lift. Record this information on the Lift Approval Form. Perform a QC inspection of the compacted lift by observing the CAES control screen for evidence of</p>	<p>Verify that the required inspections are being performed and documented.</p> <p>Perform a monthly assessment of the compaction documents generated by the QC technician.</p>

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<p>number of wheel passes is reported by CAES when the pixel turns green. Furthermore, a maximum of five non-green pixels shall be adjacent to each other within the lift area limits. "Adjacent" means that two pixels share a common side; pixels that share only a common corner are not adjacent to each other.</p> <p>A. Additional compaction may be required if, after the minimum number of passes is complete, the minimum percentage of grid points do not exhibit adequate compaction, as reported by the CAES system.</p> <p>B. Evaluate the lift interface when compacting adjacent to previously poured CSLM. Visually inspect for obstructions (e.g., CLSM surface, irregularities in CLSM side slope, etc.) that may affect compaction data. More than five non-green adjacent pixels are permitted in this situation if QC visually observes and documents a minimum of six machine passes to within 12 inches of the obstruction.</p> <p>67) COMPACTION WITHOUT CAES: If the CAES system is not available to be used for compaction under this work element, the following requirements apply.</p> <p>A. Verbal notice shall be provided to DWMRC within 24 hours of beginning to approve lifts without CAES. This notice may be provided via email.</p> <p>B. Written notice shall be provided to DWMRC no later than three calendar days (72 hours) after beginning to approve lifts without</p>	<p>uniform and adequate compaction. This condition is indicated by having a minimum of 90 percent of the screen green. Evaluate all pixels that are not green to ensure the maximum number of adjacent pixels is not exceeded. Print the screen as a color image and include with the Lift Approval Form. Record QC inspection results on the Lift Approval Form.</p> <p>Perform a visual inspection of the CLSM/Soil interface. Identify areas of the CLSM pour that present an obstacle for the 826 compactor. Visually observe the compactor operator make a minimum of six machine passes to within 12 inches of the obstruction. Document the observations on the Lift Approval form.</p>	<p>Notify DWMRC within 24 hours of beginning to approve lifts without CAES. Provide QC with documentation of DRC notification.</p> <p>Provide written notice to DWMRC no later than three calendar days after beginning to approve lifts without CAES. Provide QC with a documentation of written</p>

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<p>CAES. The written notice shall explain why CAES is down; an estimate of when CAES will be back online; a map of the areas being compacted without CAES; and a map of interim settlement monuments over the area being compacted without CAES.</p>		<p>DRC notification. Note: Verbal and written notification may be submitted by the Engineering Manager, or designee, and then provided to Quality Assurance.</p>
<p>C. Compaction without CAES is limited to 10 calendar days per occurrence.</p>		
<p>D. Each lift and lift interface shall be compacted by at least six machine passes with the CAT 826 compactor. The lift surface shall be firm and unyielding to the compactor's weight. Additional compaction may be required if, after the minimum number of passes is complete, any of the following are observed:</p>	<p>Document that the minimum number of passes is completed for each lift area. Passes shall be counted by the QC technician or by using a GPS unit communicating with the GPS unit on the compactor.</p>	<p>Review the compaction documents generated by the QC technician.</p>
<ol style="list-style-type: none"> 1. The lift surface exhibits ruts or compression (excluding depressions caused by the tines of the compactor wheel) in excess of four inches; 2. The waste material exhibits pumping behavior, or has other indications of excess moisture content; or 3. The lift does not appear to be uniformly compacted. 	<p>Perform a visual inspection of the compacted lift surface. If rutting or other indications of inadequate compaction are present, direct the equipment operator to complete additional passes until the situation is corrected. If additional passes are unable to correct the situation, moisture adjustment or other corrective actions may be needed and the lift shall not be approved until these actions are completed. Record any problems and corrective actions taken on the Daily Construction Report.</p> <p>Survey lift elevation and thickness in accordance with Specification 62, with the further requirement that the greater of the following number of points shall be surveyed per lift:</p> <ol style="list-style-type: none"> a. At least five points; or b. One point per 2,000 square feet of lift area. 	
	<p>Record the number of passes and visual inspection</p>	

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	results on the Lift Approval Form.	
<p>68) DEBRIS PLACEMENT: For purposes of this work element, debris is defined in Specification 78 with the exception that a large object is defined as incompressible debris exceeding the debris size requirements of Specification 69.</p>	<p>Determine the volume of debris. Volume determination shall be established by either:</p> <ol style="list-style-type: none"> inspecting the debris on the lift and calculating the volume of debris, or using the manifested waste volume for shipments placed on the lift. 	
<p>Debris placed in accordance with this work element shall be limited to no more than 50 percent by volume of the compacted volume of the lift. The debris shall be uniformly distributed across the lift.</p>	<p>Inspect debris once it is spread out on the lift and prior to placement of fill material. Ensure that debris is spread out uniformly across the lift and in a manner to minimize void spaces and does not exceed volume requirements. Document the debris inspection and debris percentage calculations on the Lift Approval Form.</p>	<p>Observe in the field that the debris calculations and estimates are being performed and properly documented. Review documentation to verify that the visual observations of debris shipments are being properly performed by QC personnel or that the manifested volume of waste is used to calculate the volume of fill material required.</p>
<p>Lifts containing materials susceptible to wind dispersal shall be covered with soil-like waste, fill material, or a commercial fixative so that these materials are secured by the end of the shift the materials were placed into the lift. "Secure" means a visual inspection to confirm that cover material has been applied to all materials susceptible to wind dispersal so that no material is obviously blowing around. Plastic, etc., may be visible at the surface.</p>	<p>Document cover material used, location, and result of visual inspection to ensure materials are secure on the Daily Construction Report.</p>	
<p>69) DEBRIS SIZE: All incompressible debris placed in accordance with this work element shall be less than 16 inches in at least one dimension and no longer than 12 feet in any dimension.</p>	<p>Inspect debris placed in soil lifts to ensure that it meets the debris size requirements. Record the results in the Daily Construction Report.</p>	
<p>70) SNOW REMOVAL: When waste material is to be placed and the work area is covered with snow and/or ice, the snow and/or ice must be removed so that no more than one quarter inch remains on</p>	<p>Observe that snow is removed. Inspect the waste lift for damage. Notify the Project Manager of deficiencies/damage. Construction may not continue without corrective action and re-inspection of</p>	<p>Verify that snow removal is being performed and documented and the waste lift has been inspected.</p>

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the surface. Isolated individual clumps of snow and/or ice may be present, but shall be no larger than two inches in diameter.	deficiencies/damage. Record corrective action (where required) in the Daily Construction Report.	

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71) SCOPE: This work element applies to the Class A West, 11e.(2), and Mixed Waste embankments.		
72) LIFT IDENTIFICATION: Each lift shall be given a unique designation for testing and surveying purposes.	Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift.	Verify that a unique lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paper work for that lift.
73) LIFT ACCEPTANCE: At the time of acceptance, the date and time of lift approval shall be recorded.	The QC technician shall record the date and time of lift approval on the Lift Approval Form.	Verify that the date and time of lift approval is recorded on the Lift Approval Form.
No waste material will be disposed on a lift until the prior lift is approved, except for stored waste described in Specification 94 and 95.	Verify that the previous waste lift has been approved prior to waste disposal.	
74) LIFT THICKNESS: The waste material will be placed in lifts with a compacted average thickness not exceeding 12 inches (except CLSM lifts).	Survey the mean elevation of the top of each lift by surveying at least five points over a 10,000 square foot area. Where practical, survey the corners and at least one spot in the middle. If the average thickness of these surveys exceeds 12 inches, notify the Project Manager to have operations rework the lift. The lift shall be re-surveyed with at least five more points per 10,000 square feet after it is reworked. Survey measurements will be documented and forwarded to Quality Assurance.	Verify the frequency of measurements and compliance of test results.
75) COMPACTION: Each lift shall be compacted to 90 percent of a standard Proctor, except lifts with greater than 10 percent compressible debris, which shall be compacted to a minimum of 95 percent of a standard Proctor.	Proctors shall be performed at a rate of one test per 15,000 cubic yards (compacted) or less of a specific material type.	Verify the frequency of measurements and compliance of test results.
The moisture content of all lifts shall be equal to at least two percent and no greater than up to three percentage points above the optimum moisture (except for CLSM lifts).	Except for CLSM lifts, conduct in-place moisture-density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 1,000 cubic yards (compacted) of a single lift. At least one test will be performed per lift. At least one	

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	<p>test will be performed per soil type in the lift. The test location shall be chosen on the basis of random numbers (described in Specification 12) and will be documented on the Lift Approval Form. Approve lots for compaction criteria where:</p> <ul style="list-style-type: none"> a. material is observed to be properly compacted across the surface of the lot; and b. moisture/density test results meet moisture and compaction specifications. <p>For lots where the dry density reading from a nuclear gauge moisture/density test is less than or equal to the required percentage of the standard Proctor and/or moisture content is less than two percent or greater than three percentage points above optimum moisture:</p> <ul style="list-style-type: none"> a. Identify the lot(s) (including dimensions) requiring further compaction, and re-work the material. Re-test at the location previously tested. Test one more location in each re-worked lot. Identify the test location using the lot dimensions and random numbers (described in Specification 12). <ul style="list-style-type: none"> 1) If the test results from both tests meet moisture/density requirements, approve the lot; 2) If either test fails, repeat the above process until all tests at both locations meet moisture and compaction requirements. <p style="text-align: center;">- OR -</p> <ul style="list-style-type: none"> b. If the lot is observed by the QC Technician to be adequately compacted, investigate the 	<p>Ensure that resolution of any reworked lots are properly accomplished and documented.</p>

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	<p>reason for the low density reading. If it is determined that the test results were <u>improperly influenced</u> (e.g. debris directly beneath the gauge), take two more density tests within five feet of the original test. Note: <u>All tests are to be recorded on a Field Density Test form.</u></p> <p>If the results from both tests meet moisture/density requirements, record both tests and approve the lot.</p> <p>If either test fails to meet moisture/density specifications – and the test results were not improperly influenced as described above - follow instructions for a.2 above.</p>	
<p>76) CLASSIFICATIONS: One soil classification test shall be performed at six month intervals for each large soil waste generator.</p>	<p>Perform a soil classification test (ASTM D2487) every six months for each large soil waste generator. Perform this test at a random location as described in Specification 12. A large soil waste generator is defined as a generator disposing of at least 30,000 cubic yards (compacted) of compactable soil in a given calendar year. Record the location of the classification sample on the Sampling Log.</p>	<p>Verify the sampling frequency is met.</p>
<p>77) TERRACING OF LIFTS: Lifts constructed at time more than 30 days apart from each other shall have at least three feet, measured horizontally, removed from the outer edge of the old lift (except for CLSM lifts).</p> <p>For lifts that interface with CLSM; in addition to the moisture-density testing of the lift, one moisture-density test shall be performed to verify requirements are met at the CLSM/soil interface. This CLSM/soil interface density test shall be</p>	<p>Inspect the intersections of old and new lifts. Verify that the outer three feet of the old lifts are being removed (except for CLSM lifts). Document inspections on the Lift Approval Form. Record any problems on the Daily Construction Report.</p> <p>For lifts that interface with CLSM: Perform the moisture-density test in within four feet of the CLSM interface. Moisture-density testing and corrective actions, when required, shall be performed and documented in accordance with Specification 75 with</p>	<p>Verify that the required inspections are being performed and documented.</p> <p>Verify the frequency of measurements and compliance of test results.</p>

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performed within four feet of the CLSM/soil interface.	the exception that an interface moisture-density test is not required for each soil type.	
DEBRIS PLACEMENT (Specifications 78 thru 83)		
78) DEBRIS DEFINITION: For the purposes of this CQA/QC manual, debris is defined as any radioactive waste for disposal other than compactable soils. Compactable soil is defined as:		
A. material that will pass through a four inch grizzly;		
B. having a bulk density greater than seventy pounds per cubic foot dry weight in accordance with ASTM D698; and		
C. having soil-like properties (i.e., standard tests in accordance with waste placement procedures can be performed.		
Additionally, debris shall be classified as either incompressible debris (i.e. concrete, stone, or solid metal) or compressible debris (all other debris types). A large object is defined as incompressible debris exceeding the debris size requirement of Specification 82. A large component is defined as a large object that weighs more than 100,000 pounds.		
79) DEBRIS PLACEMENT METHODS: Debris may be placed in the embankment using two different methods:		
A. placement of the debris in a lift with compactable soil at a limited ratio of debris to soil as defined in Specification 80; or		

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<p>B. placement of the debris in a lift and in-filling the debris with Controlled Low Strength Material (CLSM).</p> <p>For placement of large components, the maximum allowable load on the clay liner surface must be less than 3,000 psf.</p> <p>When CLSM is required as structural fill in the Large Component Engineering Review in order to meet the load specification, the first 4 feet of CLSM shall be placed around the large component within 30 calendar days of large component disposal.</p>	<p>Have the Engineering Manager perform a Large Component Engineering Review. Ensure that the bearing pressure at the clay liner surface meets specification for the load associated with placement of any large component.</p> <p>Document the date of large component disposal and the date of the CLSM pour and include with the Lift Approval Form.</p>	<p>If CLSM is required to meet the load specification requirement, verify the first four feet of CLSM was placed around the large component within 30 calendar days of large component disposal.</p>
<p>80) DEBRIS QUANTITY IN SOIL WASTE LIFTS: Debris that is placed in an embankment with compactable soil shall be limited to a percentage of the total volume of the waste lift, or portion of the lift designated for debris placement. Furthermore, the debris shall be uniformly distributed across the lift, or portion of the lift designated for debris placement.</p> <p>For compressible debris, the volume of the debris in a lift, or portion of the lift designated for debris placement shall be limited to less than or equal to thirty percent 30 percent by volume of the calculated compacted volume of the lift, or portion of the lift designated for debris placement.</p> <p>Incompressible debris (concrete, stone, or solid metal) may be placed in a lift, or portion of the lift designated for debris placement up to 25 percent by volume of the calculated compacted volume of the</p>	<p>For shipments containing debris material, determine the volume of debris for the shipments. Volume determination shall be established by either:</p> <ol style="list-style-type: none"> a. inspecting the debris in the shipment and calculating the volume of debris; or b. using the manifested waste volume. <p>Inspect debris once it is spread out on the lift, or portion of the lift designated for debris placement prior to placement of fill material. Ensure that debris is spread out uniformly across the lift, or portion of the lift designated for debris placement and in a manner to minimize void spaces and does not exceed volume requirements. Document the debris inspection and debris percentage calculations on the Lift Approval Form.</p>	<p>Observe in the field that the debris calculations and estimates are being performed and properly documented.</p> <p>Review documentation to verify that the visual observations of debris shipments are being properly performed by QC personnel or that the manifested volume of waste is used to calculate the volume of fill material required.</p>

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<p>lift, or portion of the lift designated for debris placement.. When combining the two types of debris in one lift, or portion of the lift designated for debris placement, the above volume limit applies and the maximum volume of all debris shall be less than or equal to 25 percent.</p>		
<p>81) WIND DISPERSIBLE DEBRIS: Lifts containing materials susceptible to wind dispersal shall be covered with soil-like waste fill material or a commercial fixative so that these materials are secured by the end of the shift the materials were placed into the lift. “Secure” means a visual inspection to confirm that cover material has been applied to all materials susceptible to wind dispersal so that no material is obviously blowing around (however, “secure” material may potentially be dislodged, but is required to remain within the restricted area of the facility). Plastic, etc., may be visible at the surface.</p>	<p>Perform a visual inspection to verify that lifts containing materials susceptible to wind dispersal are covered with soil-like waste fill material or a commercial fixative by the end of the shift the materials were placed into the lift. Document the inspection and any corrective actions on the Daily Construction Report.</p>	<p>Review documentation to verify that the visual observations of debris shipments are being properly performed by QC personnel.</p>
<p>82) DEBRIS SIZE: Incompressible debris placed in soil waste lifts shall be less than 10 inches in at least one dimension, and no longer than 12 feet in any dimension.</p>	<p>Inspect debris placed in soil lifts to ensure that it meets the debris size requirements. Document on the Daily Construction Report.</p>	<p>Review documentation associated with debris lifts to verify that debris inspections are being performed.</p>
<p>83) RESIN LIFTS: Unless disposed in the Containerized Waste Facility, resins shall be disposed as follows or in accordance with Specification 90.</p>		
<p>A blending layer of native soil shall be spread across a lift prior to placement of the resin. The blending layer material shall be defined as CL based on the Unified Soil Classification system.</p>	<p>Perform laboratory classification tests (ASTM D2487) on native soil at a rate of one test per lot prior to placement of resins. A lot is defined as a maximum of 250 cubic yards (compacted) of specified material type. Record the location of the classification sample on the Sample Log.</p>	<p>Review documentation associated with resin lifts to verify blending and disposal requirements are being performed.</p>

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Prior to spreading resins across the blending layer, there shall be no depressions or wheel ruts deeper than one inch.	Prior to placement of resins, survey the blending layer and inspect the surface for depressions and wheel ruts. Include the survey report with the Lift Approval Form. Document inspection results, discrepancies identified, and corrective actions taken on the Lift Approval form.	
Resins are limited to a maximum of 10 percent, by volume, of the blending layer of lift. Prior to blending resins shall be evenly spread across the lift with no areas larger than 25 square feet without resins and resins shall be less than one inch thick at any location.	<p>Inspect the spread resin prior to tilling to ensure:</p> <ul style="list-style-type: none"> a. resin is less than one inch thick at any location on the surface of the lift and is proportioned at a maximum of 10 percent, by volume, of the compacted lift; b. resin is spread throughout the resin lift area; c. there are no areas larger than 25 square feet without resin; <p>Require additional spreading for any resin lift not meeting these specifications. Record the debris inspection on the Lift Approval Form.</p>	
Resins shall be thoroughly blended with the blending layer and covered with a minimum of two inches of clay prior to compacting. The total lift thickness (blending layer plus the clay cover) shall be limited to one foot. The clay cover must be placed by the end of each work day. The approved cover may be used as part of the blending layer for the next resin lift.	Verify resins have been thoroughly blended with the blending layer prior to placement of clay cover. Verify that a minimum of two inches of clay cover has been placed by the end of each workday and document on the Daily Construction Report. Perform moisture and density testing in accordance with Specification 75.	
The DWMRC shall be notified at least 48 hours in advance of the placement of blended materials beyond this two inch clay layer.	Obtain documentation of DWMRC notification.	Notify the DWMRC at least 48 hours in advance of the placement of blended materials beyond the two inch clay layer. Provide QC with documentation of DWMRC notification.
CLSM POURS (Specifications 84 thru 93):		
84) CLSM PYRAMID:		
A. CLSM lifts shall form a pyramid with a final	Determine the location of the northwest corner and the	Verify compliance with this specification and proper

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<p>maximum 3H:1V outside edge slope. Thus, with a six foot CLSM lift and six inch cap, the next CLSM tier must be constructed to minimum of 19.5 feet inside the edge of the lift immediately below it.</p> <p>B. The pyramid base dimensions and maximum 3H:1V side slope requirements will control the location of all subsequent CLSM lifts throughout the full height of the embankment.</p> <p>C. Adjacent pyramids shall not be placed above any portion of previous CLSM pyramids.</p> <p>CLSM Lift Preparation: The average height of each pour shall be six feet or less. Large objects taller than six feet shall be poured with the subsequent CLSM pours (in layers) until completion. The height restriction does not include the six inch cap, if applicable, or CLSM used for repairs in accordance with Specification 92a.</p> <p>Debris disposed with CLSM will be placed to minimize the entrapment of air in the CLSM pour.</p>	<p>dimensions of each lift and document on the Lift Approval Form. Use the lift location and dimensions to ensure compliance with this specification. Document the dimensions of the previous CLSM lift on the Lift Approval Form. In locating a new pyramid, document on the Lift Approval Form:</p> <p>a. The pyramid base is placed on the Liner Protective Cover; or,</p> <p>b. The pyramid base has not been placed above a previously placed pyramid.</p> <p>Perform an inspection of the preparation of debris for placement with CLSM. Ensure that the average formed height of the CLSM lift is less than six feet and that any large objects are localized into specific areas.</p> <p>Ensure that debris is placed in a manner to minimize the possible entrapment of air during the CLSM pour and to allow maximum in-filling of the debris. Document the inspection on the CLSM Inspection Form.</p>	<p>documentation of the QC requirements.</p> <p>Review inspection documentation to verify that inspections are performed and properly documented.</p>
<p>85) DWMRC NOTIFICATION FOR CLSM POURS: The DWMRC shall be notified at least 48 hours in advance of any CLSM pour. A CLSM pour will be defined as a formed area approved and documented by QC for CLSM designated on a waste lift.</p>	<p>Obtain documentation of DWMRC notification.</p>	<p>Notify the DWMRC at least 48 hours in advance of any CLSM pour. Provide QC with documentation of DWMRC notification.</p>

86) CLSM DESIGN SPECIFICATIONS:

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<p>Notwithstanding the following specifications, Macro Vaults as approved by the DWMRC in the Mixed Waste Landfill Cell are considered large objects that do not require CLSM. Macro Vaults shall not be proof-rolled.</p> <p>CLSM shall have the following characteristics:</p> <p>A. The design mix is approved by the Engineering Manager prior to use in the cell area and meets the material specifications provided in Table 2 “Material Specifications for Portland Cement CLSM”.</p> <p>B. The CLSM passes a Slump Test (ASTM C143), Flow Consistency Test (ASTM D6103) or Efflux test (procedure provided in Appendix B of this Manual), as applicable. Passing criteria for each test is specified in Table 2 “Material Specifications for Portland Cement CLSM”.</p>	<p>Two types of tests will be performed to ensure that the CLSM meets the design specifications: initial screening tests and lot acceptance tests. The results of these tests and corrective actions, if any, shall be documented on the CLSM Testing Form.</p> <ol style="list-style-type: none"> a. Initial screening tests shall be performed on the first load of CLSM for each day that CLSM is poured. This screening test shall be performed from the “front end” of the load. The initial screening test includes either a Flow Consistency Test (ASTM D6103) or Efflux test (procedure given in Appendix A. The results from this initial screening test shall indicate whether or not any adjustments need to be made at the batch plant to ensure loads meet design specifications. b. If adjustments are made to the load to produce a product that passes the testing requirements, perform initial screening testing on the subsequent two loads to verify that the batch plant adjustments are sufficient c. CLSM pouring shall only be authorized to proceed upon verification that the initial load (and subsequent two loads if the initial load failed) meets mix specifications. d. Acceptance tests shall be performed at a rate of one 	<p>Verify the frequency of measurements and compliance of test results.</p>

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	<p>test per lot, with a minimum of one acceptance test performed for each CLSM pour. A lot is defined as 100 cubic yards of CLSM. Sampling for acceptance tests shall be performed in accordance with ASTM D5971 (“Practice for Sampling Freshly Mixed CLSM”). These acceptance tests shall be performed from a composite of two samples from near the middle of the load.</p> <ol style="list-style-type: none"> 1) Accept loads that meet specification. 2) For loads with unsatisfactory results, accept the first part of the load and reject the remainder, or modify the load and/or pour techniques and retest. 	
C. The CLSM shall have minimum 28-day strength of 150 pounds per square inch (psi) as determined by ASTM D4832. A minimum of three cylinders shall be cast for compressive strength testing.	<p>Cast a minimum of three cylinders per 2,000 cubic yards of CLSM placed, with at least one set per lift for lifts smaller than 2,000 cubic yards. Perform compressive strength testing in accordance with ASTM D4832 at 28 days to ensure the minimum strength requirements are met. This test may be performed in-house or sent off-site to an AMRL certified laboratory. If the CLSM does not meet specification, evaluate why it failed and implement corrective actions to prevent recurrence. Record the reason for the failure and the corrective action on the Lift Approval Form.</p>	<p>Verify compressive strength testing is being performed at the correct frequency.</p>
E. The CLSM shall have a wet unit weight in all cases of at least 100 lbs/ft ³ as determined by ASTM D6023 “Standard Test Method for Density (Unit Weight), Yield, Cement Content, and Air Content (Gravimetric) of Controlled Low-Strength Material (CLSM)”.	<p>Conduct a unit weight test (ASTM D6023) in conjunction with sampling for compressive strength testing of Specification 86.C.</p>	<p>Verify unit weight testing is being performed at the correct frequency.</p>
D. A load ticket shall be furnished for each truck of CLSM to be poured.	<p>Obtain the load ticket for each truck load of CLSM and ensure the load meets the mix specifications provided in Table 2 “Material Specifications for Portland Cement CLSM” of this Manual. Reject any loads not</p>	<p>Verify that the load tickets have been obtained by QC personnel for each truck load of CLSM and that the load ticket has been checked against Table 2 “Material Specifications for Portland Cement CLSM”</p>

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<p>87) CLSM PLACEMENT OF UNCONTAINERIZED DEBRIS: Debris shall be placed to minimize the entrapment of air in the CLSM pour. To accomplish this, any plastic caps, wrappings, or other obstructions placed on pipes, valves, and other debris objects shall be cut or removed prior to pouring CLSM. The uncontainerized debris shall be spread horizontally across the lift. Any compressible debris in the lift shall be secured to ensure proper disposal and cover with CLSM. Any wood materials shall be spread throughout the lift to prevent localized stacking or concentration of wood materials.</p>	<p>meeting the mix specifications. Include the load ticket with the Lift Approval Form for the CLSM lift. During each CLSM pour, a QC Technician shall be present at or near the pour at all times and shall visually observe pour activities. Document discrepancies on the Daily Construction Report.</p> <p>Visually inspect the debris pour to ensure that the CLSM can flow throughout all uncontainerized debris in the waste matrix. Inspect pipes, valves, and other debris objects and ensure that sufficient access exists for CLSM to enter the debris interior and fill voids. Verify that all compressible debris is properly secured. Ensure that wood materials are spread throughout the lift and not stacked or nested together.</p>	<p>Verify the large debris inspections have been performed and documented on the CLSM Inspection and Testing Form.</p>
<p>88) CLSM POURS WITH DEBRIS-FILLED CONTAINERS: In-filling of debris inside containers with CLSM shall be maximized. A minimum of two holes shall be punched into the bottom of one of the walls of each box container to allow for flow throughout the container. Containers filled with primarily wood materials shall not be disposed with CLSM, and must be emptied and spread out prior to placement.</p>	<p>Lids shall be removed from all box containers prior to pouring CLSM (unless a specific waste stream or shipments are exempted by DWMRC for safety or ALARA considerations). Drum containers do not require removal of the lid. However, a drum container lid shall be pierced</p> <p>Visually inspect compressible debris inside containers to ensure the debris is secured. Ensure lids are removed from all box containers. If the lid shall remain on the drum container (or other waste container specifically exempted by DWMRC), ensure that the lid has been pierced with at least one hole for drums and two holes</p>	<p>Review inspection results to ensure that compressible debris is being properly secured and that adequate holes exist for containers where lids remain on the container.</p>

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<p>with a hole size of at least eight square inches (i.e., two inch by four inch) to allow flow of CLSM into the container. If any container includes compressible debris, the material shall be secured to remain inside the container. Containers that contain compressible debris shall have the lid removed or a six-inch CLSM cap shall be placed over the filled container.</p>	<p>for boxes. Holes shall be a minimum of eight square inches (i.e., two inch by four inch). Record results on the CLSM Inspection Form.</p>	
<p>Hot particles are very small, often microscopic discrete radioactive fragments with high specific activity. Their presence or potential presence in a waste stream is documented on the waste profile record. To protect worker health and safety, waste containers containing asbestos, beryllium, DU metal or hot particles do not require in-filling of debris inside the containers to be maximized. Box lids and at least one wall shall be punctured with a minimum of two holes at least eight square inches (i.e., two inch by four inch). Containers placed in this manner shall be marked as “asbestos”, “beryllium”, “DU” or “hot particle” waste and shall have a six inch CLSM cap placed over them.</p>	<p>Ensure that containers with asbestos, beryllium, DU metal or hot particle waste are marked. Document the location of each such container within the pour on a survey report or a map of the area. Ensure that the lift is not approved without placement of a six-inch CLSM cap.</p>	
<p>89) CLSM POURS WITH SOIL-FILLED CONTAINERS: Containers that are filled with soil-like materials may be placed with CLSM. The lid may remain on the container. However, a minimum of two holes of at least eight square inches (i.e., two inch by four inch) must be placed in the lid as required for compressible debris-filled containers in Specification 88.</p>		
<p>90) CLSM POURS WITH RESIN-FILLED CONTAINERS: Containers that include or are filled with ion-exchange resin materials may be placed with CLSM. Cardboard, wood, and soft</p>	<p>Verify that ion-exchange resin containers are constructed of steel or poly. Document this inspection on the CLSM Inspection Form.</p>	<p>Review documentation to ensure CLSM pours have been documented according to this specification.</p>

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plastic “supersack” containers are expressly prohibited from use as the sole container for resin disposal in CLSM.	Assure operations documents the results of the free liquid inspection and container numbers.	
At least ten percent of all resin-filled containers placed in each CLSM lift area shall be tested for free liquids.	Document that the container has been painted or marked as required.	
Resin filled containers shall be clearly marked on their lids designating resins are present in the container. HIC liners are assumed to contain resins and do not need a marking.	Document that lids have been removed or punched with the correct number and size of holes.	
Prior to pouring CLSM, caps (internal access point for HICS and other liners) may be removed from liners, with steel caps exceeding 0.5 inches thickness, to fill headspace voids. For all other containers, lids may not be removed. If not removed, lids of cylindrical containers of diameter less than three feet shall be pierced with one hole of size of at least eight square inches (i.e., two inch by four inch) to allow flow of CLSM into the container headspace void. If not removed, lids or the highest surface of all containers, other than cylindrical of diameter less than three feet, shall be pierced with a minimum of two holes of size of at least eight square inches (i.e., two inch by four inch) to allow flow of CLSM into the container void space.	Verify and document that CLSM drop height does not exceed limitation and CLSM overflow is minimized.	
When filling a container, CLSM shall not be dropped from a height exceeding 10 feet, as measured from the point of discharge to the highest surface of the resin-filled container, and pouring methods shall minimize CLSM overflow from within the containers into the surrounding pour areas.	Verify and document that CLSM pouring methods prevent intermixing of CLSM used for filling headspace voids with CLSM used to cover the remainder of the container.	

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<p>CLSM poured across the top of the resin-filled containers shall not intermix with the CLSM used for filling headspace voids (e.g., CLSM used for filling headspace voids shall be allowed to harden prior to pouring across the top of the container).</p>	<p>Prior to the CLSM pour, calculate the ratio of resins to other material in the pour as follows:</p> <ol style="list-style-type: none"> Document the container type and volume for each container of resins in the pour; Document the total pour volume based on the formed area x height; Resin volume divided by total volume x 100 = resin percentage. Container volume may be calculated from the nominal capacity or from manifested volume of resins in the container. 	
<p>All resin-filled containers shall have a six inch CLSM cap placed over the filled container.</p>		
<p>The total waste resin volume shall be limited to no more than 25 percent of the total volume of the CLSM pour. Other wastes meeting the criteria for CLSM disposal, as outlined in this CQA/QC Manual, may be used to make up the remainder of the volume of the pour.</p>		
<p>Except for the placement of boxes containing drums and other smaller resin-filled packages, containers of ion-exchange resins shall not be placed directly adjacent to each other within the CLSM pour. Containers of ion-exchange resins shall not be placed directly above containers of ion-exchange resins in previous lifts within the CLSM pyramid.</p>	<p>Survey and document the location of resin-filled container and include with the Lift Approval Form. Verify that resin-filled containers are not placed directly above resin-filled containers in previous lifts within the CLSM pyramid.</p>	
<p>91) FINAL CLSM POUR SURFACE: The final CLSM surface will be a horizontal plane with no exposed debris that impedes contact with the surface area during proof rolling (with the exception of large objects that require multiple pours to completely dispose with CLSM).</p>	<p>Visually inspect the final CLSM pour surface to ensure the area is acceptable for proof rolling.</p>	
<p>92) PROOF-ROLL TESTING: A proof roll test shall be performed on all CLSM lifts a minimum of three calendar days following completion of the CLSM pour and prior to placement of any additional waste lifts on top of the completed pour.</p>	<p>Inspect the entire cured CLSM pour surface. Following inspection, direct the truck (rock truck, cement truck, or other vehicle of equal or greater surface load) across the entire CLSM pour surface. Inspect the surface during rolling for any cracking or depressions resulting</p>	<p>Review the documentation to ensure proof-roll testing is being performed and properly documented.</p>

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<p>The test shall consist of a loaded truck (rock truck, cement truck, or other vehicle of equal or greater surface load) driving across the entire footprint of the completed CLSM pour.</p>	<p>from the proof-rolling. Identify any surface cracks or depressions with a vertical displacement of one-half inch or greater, or cracks greater than ½-inch in depth. Mark these areas for repair or re-work. Document observations on the Lift Approval Form.</p> <p>Approve all lift areas not marked for repair or rework. For any areas with surface cracking or depressions with a vertical displacement of one-half inch or greater, or cracks greater than one-half inch in depth, one of the following methods shall be followed to remedy the failed area(s):</p> <ol style="list-style-type: none"> a. The area may be compacted and then re-poured. Following three days from the re-pour, perform another proof-roll test to evaluate if the repair was adequate; or b. Remove the CLSM and debris from the marked area and replace it with debris and CLSM. Following three days from the re-pour, perform another proof-roll test of the area to evaluate if the repair was adequate. Repeat this process until satisfactory results are achieved; or c. Place a six-inch CLSM cap over the pour lift area after the area in question has been compacted. With the exception of edges at the perimeter of a lift, the six-inch cap shall extend a minimum of three feet past the damaged areas created during proof-rolling in each direction. Following a minimum of three calendar days, perform a proof-roll test of the six-inch cap area to evaluate if the cap was adequate. This process may also be repeated (i.e., placement of additional cap to a 12-inch cap) until satisfactory results are achieved. 	<p>Review the documentation to ensure rework, if required, has been performed and documented.</p>

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<p>93) SIX-INCH CAP: A six-inch cap is required as described in Specification 88 and 90. Additionally, a six inch cap may be utilized for repairs to CLSM pours that do not pass the proof-rolling test of Specification 92. Areas poured with a CLSM cap shall still require a proof-rolling test (as described in Specification 92) to verify performance of the cap. With the exception of edges at the perimeter of a lift, the six inch cap shall extend a minimum of three feet in each direction past the edge of the area that requires a cap.</p> <p>The six inch cap shall have minimum 28-day strength of 500 psi as determined by ASTM D4832. Table 2 specifications do not apply to the CLSM cap.</p>	<p>Visually inspect the CLSM pour area and identify the highest elevations of debris that requires a six-inch cap. Survey and document these designated elevations on the CLSM Inspection Form. Following completion of the six-inch cap, perform a final survey of the lift as required for determining lift thicknesses above. Document the survey on a survey report. Ensure that the thickness of the cap is six inches above all debris requiring a CLSM cap. Document the inspection and completion of the CLSM cap on the Lift Approval Form.</p> <p>Perform compressive strength testing of the CLSM used for caps at the rate of one test per 1,000 cubic yards of CLSM placed, with at least one test per lift. Test specimens/samples shall be collected in accordance with ASTM D5971. The samples shall then be tested in accordance with ASTM D4832. The test results are documented in the contractor's compressive strength report which is referenced on the Lift Approval Form. If the CLSM cap does not meet specification, evaluate why it failed and implement corrective actions to prevent recurrence. Document corrective actions on the Daily Construction Report.</p>	<p>Review the documentation associated with the CLSM cap.</p> <p>Verify that compressive strength testing is performed at a rate of one per CLSM lift. Ensure that the compressive strength of the cap is greater than or equal to 500 psi.</p>
<p>94) LLRW STORED WASTE: Any waste material taken to the disposal cell but not spread out (for lifts placed with compactable soil) or set into a CLSM lift area for forming (for debris to be placed using CLSM) shall be considered in-cell bulk disposal/stored waste. In-cell bulk disposal/stored waste may be temporarily managed in piles up to twenty-five feet high on the embankment. The total volume of waste in storage shall not exceed the volume reported in the current LLRW Surety.</p> <p>Open-air storage of PCB/Radioactive waste and</p>	<p>On a monthly basis, calculate and document the volume of in-cell bulk disposal/stored waste and waste stored on the LLRW storage pads. Stop waste unloading before the volume of waste stored exceeds the volume specified in the current LLRW Surety.</p> <p>Obtain reports from waste disposal personnel as to the</p>	<p>Review documentation of in-cell bulk disposal and ensure that volumes do not exceed the current LLRW Surety.</p>

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<p>Dry Active Waste (DAW) is prohibited. DAW is defined in Ground Water Quality Discharge Permit UGW450005. In-cell bulk disposal of PCB and DAW shall be managed to prevent open-air storage as follows:</p> <ul style="list-style-type: none"> A. Maintained in a water-tight container; or B. Covered within 24 hours of the end of the shift that the waste was unloaded with a nominal six inches of soil or soil-like waste material that is free of PCB and DAW; or C. Covered within 24 hours of the end of the shift that the waste was unloaded with a commercial fixative to prevent wind dispersal and leachate generation, applied in accordance with the manufacturer's instructions; or D. The following PCB wastes do not require cover to prevent wind dispersal: <ul style="list-style-type: none"> 1. Drained equipment; 2. Large objects with inaccessible PCB contamination; or 3. PCB bulk product waste (as defined in 40 CFR 761.62(b)(1)(i)) with a bulk density greater than 70 pounds per cubic foot. 	<p>location and status of PCB and DAW in-cell bulk disposal/stored waste at the beginning of each shift. When material requiring cover has been placed into in-cell bulk disposal during the preceding shift, track placement of the specified cover material. Document completion of cover within the required timeframe on the Daily Construction Report.</p>	
<p>When cover is required, document the date and shift that PCB and DAW were placed in in-cell bulk disposal/storage and the date and shift that cover was applied.</p> <p>95) 11e.(2) STORED WASTE: Any waste material taken to the disposal cell but not spread out (for lifts placed with compactable soil) or set into a CLSM lift area for forming (for debris to be placed</p>	<p>On a monthly basis, calculate and document the volume of in-cell bulk storage. Stop waste unloading before the volume of waste stored exceeds the volume specified in Condition 10.8.e. of RML #UT 2300478.</p>	<p>Review documentation of in-cell bulk disposal and ensure that volumes do not exceed the License limit.</p>

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<p>using CLSM) shall be considered in-cell bulk storage. In-cell bulk storage may be temporarily managed in piles up to twenty-five feet high on the embankment. In-cell bulk storage cannot be placed on slopes steeper than approximately 5H:1V. The volume of in-cell bulk storage shall not exceed the limit found in RML #UT 2300478, condition 10.8.e. In order to prevent excess stockpiling, all bulk storage waste shall be disposed by August 1 of each year.</p>		
COLD WEATHER PLACEMENT (96 thru 98)		
<p>96) FROZEN MATERIAL: No frozen material shall be disposed directly on or within 24 inches of the clay liner. Frozen material is defined as material which cannot meet the compaction requirements because of frozen water mixed within the material.</p>	<p>During cold weather, inspect material to be disposed directly on the clay liner. Do not allow frozen material to be disposed on the clay liner. Record corrections on the Daily Construction Report.</p>	<p>Verify that inspections for frozen material are being conducted during cold weather and that any corrective actions (if required) are properly documented.</p>
<p>97) PLACEMENT OF WASTE DURING COLD WEATHER: Waste material shall only be placed when the required moisture and compaction can be met.</p>		
<p>For soil lifts:</p>	<ol style="list-style-type: none"> a. On November 1, decrease density and moisture lot size to 750 cubic yards (compacted). b. On December 1, and continuing to March 1, decrease density and moisture lot size to 500 cubic yards (compacted). c. When two consecutive tests fail compaction requirements due to frozen material the lift is classified as in-cell bulk disposal/storage and managed in accordance with Specification 94. This action will be noted in the Daily Construction Report. 	<p>Verify that the testing frequency is increased at the beginning of November, and December. Verify that waste failing two consecutive compaction tests are classified as in-cell bulk disposal/storage and noted in the Daily Construction Report.</p>

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<p>For CLSM pours:</p> <p>A. Do not pour CLSM on a frozen base.</p> <p>B. If the ambient air temperature is forecast to drop below 5°F anytime during the CLSM pour, CLSM shall not be poured. When the ambient or expected air temperature will fall below 35°F anytime during the CLSM pour, the CLSM shall be sampled and an initial screening test performed as outlined (Specification 86). This initial sample may be used to prompt an adjustment of the load water content or temperature, modify the pour</p>	<p>d. When temperatures are high enough to place the in-cell bulk disposal/storage material, place the material in accordance with Specifications 74 and 75, and in accordance with the following criteria:</p> <ol style="list-style-type: none"> 1) If more than two feet of waste was stored as in-cell bulk disposal/storage, excavate to a maximum of 12 inches above the last approved waste lift. Test and approve this in accordance with Specifications 74 and 75. 2) If less than two feet of waste was stored as in-cell bulk disposal/storage, excavate to the top of the last approved lift and re-test this lift in accordance with Specifications 74 and 75. <p>If ambient temperatures are less than 35°F for three successive days, the pour area shall be tented and heated for 24 hours prior to pouring. The temperature inside the tented area shall be continuously monitored on the opposite end of the tent from where heat is being applied. The ambient temperature within the tented area shall be greater than 50°F for a minimum of 12 hours prior to pouring.</p> <p>When the ambient or expected air temperature will fall below 35°F anytime during the CLSM pour, perform an initial screening test of the CLSM immediately before pouring to ensure that it meets the flowability criteria. This screening test includes either a Flow Consistency Test (ASTM D6103) or Efflux test (procedure given in Appendix A). The result from this initial screening test shall indicate whether or not any adjustments need to be made at the batch plant to</p>	<p>When required, review documentation of tenting, heating, and temperature measurements.</p> <p>During freezing conditions, verify that QC personnel have performed initial sampling and testing of the CLSM to ensure flowability. Verify that the CLSM has been covered with concrete blankets or tented and heated, where required. Verify that QC personnel have periodically checked the temperature of the CLSM and recorded the results on the CLSM Inspection and Testing Form.</p>

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<p>techniques, motivate rescheduling of the pour event, etc., but should not be considered acceptance sampling and testing. Acceptance sampling and testing should be obtained in accordance with ASTM D5971 (Sampling Freshly Mixed CLSM).</p> <p>C Unless the ambient air temperature is at least 35°F and rising, measures must be taken to ensure the CLSM temperature does not fall below 40°F. To ensure this occurs and therefore the CLSM can adequately cure prior to exposure to freezing temperatures, the following should occur: Limit the pour to a surface area of no more than 4,800 square feet. Heat the CLSM prior to pouring (as possible). Cover, or tent and heat, the CLSM directly following pouring (i.e., pour one truck load, cover or tent the in-place material, then pour the next truck load). Following completion of the pour, cover the CLSM with concrete blankets, or tent and heat the CLSM. Likewise, if following placement, the ambient air temperature decreases below 35°F, or is anticipated to decrease below 35°F anytime in the 24 hours following placement,</p>	<p>ensure loads meet design specifications.</p> <p>a. If adjustments are made to the load to produce a product that passes the testing requirements, perform initial screening testing on the subsequent two loads to verify that batch plant adjustments are sufficient.</p> <p>b. CLSM pouring shall only be authorized to proceed upon verification that the initial load (and subsequent two loads if the initial load failed) meets mix specifications.</p> <p>Perform acceptance sampling and testing from near the center of the load.</p> <p>a. Accept loads which meet specification.</p> <p>b. For loads with unsatisfactory results, accept the first part of the load and reject the remainder, or modify the load and/or pour techniques and retest. Record the results on the CLSM Inspection and Testing forms.</p> <p>When the ambient air temperature decreases to below 35°F, ensure the CLSM temperature does not fall below 40°F. Measure and record the temperature of each CLSM load prior to introduction to the cell. Ensure the freshly poured CLSM is covered or tented and heated in a timely manner. Measure and record the temperature of the in-place CLSM every two hours during pouring, at the end of the work shift and at the beginning of the next work shift. Temperature results of pour temperatures shall be recorded on the "CLSM Inspection and Testing" forms. If, following placement, the ambient air temperature decreases below 35°F, or is anticipated to decrease below 35°F anytime in the 24 hours following placement of the CLSM, verify that concrete blankets or tenting and heating has been employed to ensure the CLSM is maintained greater than 40°F. Record the results of the inspection on the</p>	<p>Review documentation of CLSM temperature measurements and actions taken for cold weather pouring to verify that CLSM temperatures meet specifications.</p>

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the CLSM must be covered with concrete blankets, or tented and heated.	CLSM Inspection and Testing forms.	
98) SNOW REMOVAL: When waste material is to be placed and the work area is covered with snow and/or ice, the snow and/or ice must be removed so that no more than one quarter inch remains on the surface. Isolated individual clumps of snow and/or ice may be present, but shall be no larger than two inches in diameter.	Observe that snow is removed. Inspect the waste lift for damage. Notify the Project Manager of deficiencies/damage. Construction may not continue without corrective action and re-inspection of deficiencies/damage. Record corrective action (where required) in the Daily Construction Report.	Verify that snow removal is being performed and documented and the waste lift has been inspected.
99) FINAL GRADING BEFORE TEMPORARY COVER PLACEMENT: Top of waste elevations shall be at or below design elevations. Also, special attention shall be taken to emphasize complete and thorough void filling around and within any debris in the final waste lift.	Survey the top lift of waste on a 50 foot grid and at key points (i.e., embankment break lines). Final survey measurements will be documented on a survey report and provided to the QC Supervisor and Quality Assurance.	Review the final survey data. Verify the frequency of the survey points.
A visual inspection is performed at the top of waste surface. Any incompressible debris protruding greater than one-half foot above the design top of waste surface shall be compacted into the lift or removed.	Perform the visual inspection. Notify the Project Manager of any deficiencies. Document inspection results on the Daily Construction Report and re-inspect deficiencies. If satisfactory, notify QA that the surface is ready for QA inspection.	Perform a visual inspection of the final elevation surface and provide written approval.
100) REGULATORY APPROVAL: The DWMRC shall approve the final surface before temporary cover placement. 48 hour notification shall be provided to the DWMRC prior to placement of temporary cover material over the final waste surface. EnergySolutions may proceed with temporary cover placement 48 hours after notification if the DWMRC has not inspected and has not notified the Quality Assurance of its intent to inspect the final surface.	Obtain written authorization from Quality Assurance that the final surface has been inspected. Obtain documentation (e.g., notice of inspection, email, letter) confirming the DWMRC inspection and approval.	Notify DWMRC (by email) that the final surface is ready for inspection. Provide QC with documentation of DWMRC inspection and approval.

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<p>101) SCOPE: This work element applies to the Class A West embankment.</p>		
<p>102) NOTICE OF TEST PAD CONSTRUCTION: The Containerized Waste Facility Waste Placement Test Pad (CWF Test Pad) plan shall be approved by the DWMRC. The CWF Test Pad plan shall be provided to the DWMRC at least 14 calendar days prior to test pad construction. If DWMRC has not provided approval or deficiency notification prior to the end of 14 calendar days, construction may proceed as proposed in the CWF Test Pad plan.</p> <p>The DWMRC shall be notified 48 hours in advance of the start-up of test pad construction.</p>	<p>Obtain documentation confirming that the CWF Test Pad plan has been approved by the DWMRC or the 14 calendar day period has ended.</p> <p>Obtain documentation confirming that the DWMRC has been notified, as required.</p>	<p>Verify that the CWF Test Pad plan has been provided to the DWMRC at least 14 calendar days prior to construction of the test pad. Provide QC with documentation of DWMRC approval or documentation that the 14 calendar day period has expired.</p> <p>Notify the DWMRC 48 hours in advance of test pad construction. Provide QC with documentation of DWMRC notification.</p>
<p>103) CONTAINERIZED WASTE PLACEMENT TEST PAD: A test pad with a minimum area of 400 square feet will be constructed using this procedure (container or large component type, container configuration, backfill material properties, placement and compaction methods) proposed for construction of the waste lifts. The test pad shall be representative of anticipated field placement conditions and of dimensions suitable to the equipment to be used for production. The minimum area of the test pad may be reduced with DWMRC concurrence with the test pad plan.</p> <p>Prior to implementation of a containerized waste configuration that has not been previously approved; a waste placement test pad shall be constructed utilizing the proposed containerized waste configuration.</p>	<p>Observe the construction of test pads. Measure test pads to ensure that they are constructed to the size indicated. Record the test pad size on the Daily Construction Report.</p>	<p>Daily, observe the construction of the test pads. The quality assurance review for test pad specifications shall cover each specification in this work element. Review 100 percent of the QC documentation to verify that the tests were performed and documented correctly.</p>

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Test pads are to be constructed and tested in accordance with the following specifications:		
A Construct the proposed configuration of containerized waste in the test pad area.	Document the constructed configuration of containers in the test pad on the Daily Construction Report.	Perform a minimum of one visual inspection of the constructed configuration per test pad.
B At least one Proctor (or relative density) and classification test shall be conducted on the backfill material for each test pad.	Conduct the required proctor (or relative density) and classification (PL, LL, and gradation) tests.	Review 100 percent of the QC documentation for the test pad.
C Backfill shall be placed over and between the waste packages in a manner that encourages flow into void spaces. The backfill is to be placed and compacted by equipment and methods proposed for use during construction of the waste lifts. Other equivalent equipment may be used for placement or compaction of backfill with approval from the Engineering Manager and DWMRC.	Record type of equipment used, and number of passes on the Daily Construction Report. Verify DWMRC approval has been received for equivalent equipment when used.	
D The backfill surrounding the containers shall achieve an average density of at least 85 percent standard proctor or 55 percent relative density for drum configurations, or an average density of at least 80-percent standard proctor or 50 percent relative density around B-12 or B-25 boxes, HICs, cask liners, large components, or container overpack configurations. The completed test pad shall have no greater than one percent external void space by volume of the entire test pad.	<p>Conduct in-place moisture-density tests at a rate of at least four tests per test pad. Each test location shall be chosen to verify backfill compaction throughout the test pad. Record the test result on the Field Density Test form. Inspect the constructed test pad for void spaces surrounding the containers. Observe destructive testing of the test pad and measure external void spaces found in the backfill in accordance with the Containerized Waste Facility Waste Placement Test Pad Destructive Testing method in Appendix B.</p> <ol style="list-style-type: none"> Approve test pads which meet the specified compaction, and minimize void space conditions. Rework and retest test pads not meeting the specified moisture or compaction or minimize void space conditions. Document all rework that was performed. 	

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	c. Where rework and retesting is impractical, reject the test pad procedure.	
E. The procedures used to construct the test pad (container type, container configuration/orientation, backfill material properties, placement and compaction methods) shall be reviewed and approved by the Engineering Manager. The test must be approved by a Professional Engineer.	Provide the Engineering Manager with copies of the documentation for the test pad (all documentation associated with this work element) for review and approval.	
F. The test pad certification report shall be approved by the DWMRC prior to using the new test pad construction method. However, if the DWMRC has not provided approval or deficiency notification prior to the end of 14 calendar days from the time the certification report was submitted, construction may proceed using the new construction method.	Obtain documentation confirming that the test pad certification report has been approved by the DWMRC or the 14 calendar day period has ended.	Verify that the test pad certification report has been provided to the DWMRC. Provide QC with documentation of DWMRC approval or documentation that the 14 calendar day period has expired.

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>104) SCOPE: This work element applies to the Class A West embankment.</p>		
<p>105) LIFT IDENTIFICATION: Each lift shall be given a unique lift identification number for testing and surveying purposes.</p>	<p>Assign a lift identification number to each lift. Use the lift identification number to identify all paperwork for that lift. Summarize all lifts on the lift summary form.</p>	<p>The quality assurance review for waste placement specifications shall cover each specification in this work element. Review a minimum of 50 percent of the QC documentation to verify that the tests were performed and documented correctly.</p>
<p>106) LIFT ACCEPTANCE: At the time of acceptance, the date and time of lift approval shall be recorded.</p>	<p>The QC technician shall record the date and time of lift approval on the CWF Lift Approval Form.</p>	
<p>107) DEFINITIONS: The following terms are defined for the Containerized Waste Facility:</p> <p><u>Backfill</u> is defined as sand with a minimum of 95 percent passing the #4 sieve, a minimum of 35 percent passing the #30 sieve, and less than 10 percent passing the #200 sieve. The maximum moisture content for backfill shall be less than or equal to 4.1 percent at the time of backfill placement. This specification may be modified following successful completion of a test pad.</p> <p><u>Backfill cover</u> is defined as a minimum of one foot of soil placed over containerized waste packages after backfilling is complete. In the case of caissons, standard liners, and large liners, the backfill cover is placed over the intermediate sand layer.</p> <p><u>Containerized waste</u> is defined as any containers of Certified Containerized Waste in accordance with applicable requirements of the Waste Characterization Plan. Certified Containerized Waste is defined as monolithic units in the form of</p>		

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<p>the following filled containers.</p> <p>A. Any DOT “Strong, Tight” Containers up to five feet tall;</p> <p>B. <u>Standard Liners</u> are High Integrity Containers (HICs) or other cylindrical packages up to 6.65 feet tall (up to 215 cubic feet external volume);</p> <p>C. <u>Large Liners</u> are HICs or other cylindrical packages up to nine feet tall (up to 331 cubic feet external volume); or</p> <p>D. Other Large Components and oversized DOT containers</p> <p><u>Containerized Waste Facility (CWF) pyramid</u> is limited to a maximum of two lifts of containerized waste. Containers up to five feet tall are limited to a single lift at the pyramid base. Containers greater than five feet tall are limited to two lifts. The volume of the embankment above and surrounding the pyramid shall be filled with bulk waste lifts placed in accordance with the Bulk Waste Placement Work Element of this plan.</p> <p><u>Intermediate sand</u> is defined as a minimum of two feet of sand meeting gradation specifications for backfill, placed above the top of caissons, standard liners, and large liners.</p> <p><u>Lift</u> is defined as the six inch sand layer, containerized waste packages, backfill between packages, intermediate sand (when applicable), and the backfill cover layer. A containerized waste placement lift may contain one layer of containers</p>		

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<p>or more than one stacked layer of containers, depending on the container type and height.</p> <p><u>Removable Steel Form</u> is a circular steel form used to ensure the spacing of standard or large liners. Removable steel forms are placed in an approved disposal configuration (hexagonal for example) prior to placement of liners. Removable steel forms can be used in either the first lift or second lift in place of caissons. All removable steel forms shall be pulled after liner placement <u>and</u> before backfill.</p>		
<p>108) CONTAINERIZED WASTE PLACEMENT:</p> <p>A. All containers shall be placed in accordance with an approved container placement method. Containers shall be placed in a configuration that has been approved through the successful completion of a CWF Test Pad. Figures 7 and 8 illustrate approved waste placement configurations. A minimum six-inch layer of loose sand shall be placed prior to placement of containers. Containers shall be worked into this loose sand to minimize any voids underneath the containers. Containers shall be placed with a minimum distance as specified by individual container type below. Backfill shall be placed over and between the containers in accordance with the approved container placement method for the type of container being placed. The containerized waste placement backfill soil properties shall be tested once per 2,500 square feet of placement area or once per lift.</p>	<p>Verify through observation and document that the appropriate container placement method and spacing is followed for the type of container stacking in each lift.</p> <p>Perform at least one gradation test per 2,500 square feet of placement area, or change in backfill material type, or change in borrow source.</p> <p>Conduct an inspection of the container placement configuration prior to commencement of backfill placement. This inspection shall document that an approved configuration has been utilized for the container types present.</p> <p>Perform moisture content testing on backfill material at least once each day backfill material is placed. Observe placement and compaction of the backfill to ensure that type of equipment, equipment load (if applicable), and number of passes meet the specifications approved by the containerized waste placement test pad. Record type of equipment used, equipment load (if applicable),</p>	<p>Review the QC documentation to confirm that the appropriate container placement and backfilling method has been used and properly documented.</p>

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<p>B. Standard Liners shall be placed as follows. Spacing and backfill of standard liners may be facilitated by the use of concrete caissons or removable steel forms; use of caissons or removable steel forms is not required. Caissons or other forms shall not exceed seven feet tall. When used, removable steel forms shall be removed prior to backfill. Caissons shall not be removed without prior DWMRC notification. Backfill shall be placed to a minimum height of seven feet above the container base elevation by dropping from the bucket of a front-end loader or equivalent around and above the container (whether in a caisson or not). Backfill shall achieve a minimum density of at least 80 percent of a standard Proctor, as demonstrated by the approved test pad(s). The backfill layer shall be covered by an intermediate sand layer to a minimum depth of nine feet above the container base elevation. Intermediate sand shall achieve a minimum density of 85 percent of a standard Proctor. The backfill cover layer is then placed above the intermediate sand layer. Caissons shall be placed in a hexagonal or other approved (through a test pad) configuration, such as rectangular, that meets the following criteria. Caissons with an outer diameter of 100 inches shall be placed a minimum of four inches apart. If no caisson is used, or if a caisson or other form of smaller outer diameter is used, the container shall be placed as if the 100-inch diameter caisson</p>	<p>and number of passes on the CWF Lift Approval Form.</p> <p>Verify through observation and document on the CWF Lift Approval Form that standard liners are placed with the appropriate container placement method and spacing.</p>	

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<p>were there for spacing purposes; i.e., within a minimum area of 108-inch diameter centered around the container, no other caisson or container shall intrude.</p>		
<p>C. Unusually shaped containers shall be placed and backfilled in a manner that allows void spaces to be filled. In no case shall unusually shaped containers be placed such that a significant amount of external void space cannot be filled. A significant amount of external void space for unusually shaped containers is five percent of the volume of the unusually shaped containers in the lift, unless otherwise approved by the DWMRC.</p>	<p>Verify through observation and document that the unusual containers are placed such that all significant voids can be filled.</p>	
<p>D. Large components and oversized DOT containers shall be placed and backfilled such that void spaces are filled and the bearing capacity of the embankment is not exceeded.</p>	<p>Verify through observation and document that the large components and oversized DOT containers are placed in accordance with an approved large component placement method.</p>	
<p>E. Large Liners shall be placed as follows. Spacing and backfill of large liners may be facilitated by the use of concrete caissons or removable steel forms; use of caissons or removable steel forms is not required. Caissons or other forms shall not exceed 9.5 feet tall. When used, removable steel forms shall be removed prior to backfill. Caissons shall not be removed without prior DWMRC notification. Backfill shall be placed to a minimum height of 9.5 feet above the container base elevation by dropping from the bucket of a front-end loader or equivalent around and above the container (whether in a caisson or not). Backfill shall achieve a minimum density of at least 80 percent of a</p>	<p>Verify through observation and document that large liners are placed with an approved container placement method and spacing.</p>	

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<p>standard Proctor, as demonstrated by the approved test pad(s). The backfill layer shall be covered by an intermediate sand layer to a minimum depth of 11.5 feet above the container base elevation. Intermediate sand shall achieve a minimum density of at least 85 percent of a standard Proctor. The backfill cover layer is then placed above the intermediate sand layer. Caissons shall be placed in a hexagonal or other approved (through a test pad) configuration, such as rectangular, that meets the following criteria. Caissons with an outer diameter of 114 inches shall be placed a minimum of five inches apart and no more than 11 inches apart (at the nearest point between two adjacent caissons). If no caisson is used, or if a caisson or other form of smaller outer diameter is used, the container shall be placed as if the 114-inch diameter caisson were there for spacing purposes; i.e., within a minimum area of 124-inch diameter centered around the container, no other caisson or container shall intrude and adjacent caissons shall be within a maximum area of 136-inch diameter.</p>		
<p>F. Large Liners shall meet the following void space criteria: void spaces within the waste and between the waste and its packaging shall be reduced to the extent practicable, but in no case shall less than 90 percent of the capacity of the container be filled.</p>	<p>For large liners, document that the void space criteria is met.</p>	
<p>G. Drums shall be placed horizontally at least one inch apart in a single layer. There shall be no continuous contact between drums. Forklifts may be used for drum placement</p>	<p>Document that drums have been placed as required. Document equipment used and number of passes on a Daily Construction Report.</p>	

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<p>provided that protective measures are taken to prevent damage to the drums. The forklift tines shall not come into direct contact with the drums. Sand shall be compacted to an average standard proctor density of 85 percent with a minimum of a single pass of a hoe mounted vibratory compactor or its equivalent, prior to placement of the next layer of drums. For purposes of this specification, the “Standard I-13 Liner” and “NUHIC-55 liners” may be placed as a drum.</p>		
<p>H. When backfilling between standard or large caissons placed in a hexagonal pattern, the following controls apply as demonstrated in the “Test Pad Report for the Containerized Waste Facility Tri-Arc Test Pad Plan, Revised Plan” dated September 18, 2007. The loader or other equipment shall have a bucket of at least 25 cubic foot capacity and the bucket shall be totally filled. Dump the backfill sand from a height of approximately two feet above the top of the caisson (measured from the lower lip of the bucket to the top of the caisson).</p>	<p>Document that the bucket used to place backfill sand meets or exceeds the minimum capacity. Observe sand dumping operations for compliance with the specification. Document on the Daily Construction Report.</p>	
<p>I. If placing ion-exchange resins in containers other than standard liners or large liners, ensure that each 50’ x 50’ lift area contains no more than 25 percent resins by volume. Increase spacing of resin containers as needed to maintain this criterion.</p>	<p>Calculate the ratio of resins to other material (soil, non-resin wastes) in the lift based on manifested resin volume and actual lift dimensions. Nominal container capacity may be used instead of manifested volume. Resin volume divided by total volume x 100 = resin percentage. Document on the CWF Lift Approval Form.</p>	
<p>109) PYRAMID CONTROLS: Refer also to Figures 7 and 8. Containerized Waste Facility (CWF) Pyramid:</p>	<p>Determine the location of the northwest corner and the dimensions of each lift and document on the CWF Lift Approval Form. Use the lift location and dimensions to</p>	<p>Verify compliance with this specification and proper documentation of the QC requirements on the CWF Lift Approval Form.</p>

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<p>A. Containerized waste lifts shall form a pyramid with a maximum 3H:1V outside edge slope. The slope shall be measured to the top of the backfill cover above containers in the lift.</p> <p>B. Drums and boxes less than five feet tall are limited to a single lift on the lower layer of the CWF pyramid. Standard and large liners are limited to two lifts.</p> <p>C. The pyramid base dimensions and maximum 3H:1V side slope requirements will control the location of the second lift of containers.</p> <p>D. Adjacent pyramids shall not be placed above a previous CWF pyramid.</p> <p>E. CLSM pyramids for bulk waste shall not be placed above a previous CWF pyramid.</p> <p>F. CLSM may be used for fill within the initial lift of the container pyramid.</p> <p>G. The first liner placed in a second lift using this method shall be offset from liners in the lower lift.</p> <p>H. Large Liners placed in the upper lift of the Containerized Waste Facility shall be placed at least 75 feet from the outer perimeter of the lower lift.</p>	<p>ensure compliance with this specification. As each lift of backfill cover is placed, survey and document that the corners of the lift meet the 3H:1V slope. If applicable, document the dimensions of the previous containerized waste facility lift on the CWF Lift Approval Form. In locating a new pyramid, document on the CWF Lift Approval Form:</p> <p>a. The pyramid base is placed on the liner protective cover; or</p> <p>b. The pyramid base does not encroach the vertical limits of a previous pyramid.</p> <p>Prior to positioning the first liner in a second lift, document the location of containers in the first lift. Ensure that the first liner placed in the second lift is offset so that it is not directly above any single liner in the lower lift. Document that large liners placed in the upper lift meet the setback criteria.</p>	<p>Notify DWMRC at least 48 hours in advance of CLSM use as fill. Provide QC with documentation of DWMRC notification.</p>
<p>110) CLSM USE AS FILL: CLSM use as fill within the initial lift of the container pyramid shall comply with Specifications 84 and 85. However, CLSM used as fill at the Containerized Waste</p>	<p>Obtain documentation of DWMRC notification and Document CLSM mix inspections and approval in accordance with Specifications 84 and 85.</p>	

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<p>Facility is not required to meet the compressive strength requirement of Specification 86.</p> <p>CLSM may be used for fill with up to two, five-drum pallets stacked inside a standard or large caisson. CLSM may also be used for fill with other waste containers that fit inside a standard or large caisson. The entire caisson height may be filled in a single CLSM pour.</p> <p>CLSM may also be used for fill around containers less than five feet tall around the perimeter of the CWF pyramid, so long as the 3H:1V pyramid slope is maintained. Drums placed in this manner may be oriented vertically.</p>	<p>Verify the mean elevation of the top of each intermediate sand lift by installing grade poles, or other methods approved by the Engineering Manager. For each lift larger than 50 feet x 50 feet, survey the corners and at least one spot in the middle. For lifts less than 50 feet x 50 feet, a minimum of four grade poles, one in each direction, shall be used. Lifts larger than 50 feet x 50 feet may be segmented to areas 50 feet x 50 feet or less and elevation verified with the use of grade poles. The use of grade poles to verify the compacted thickness of the intermediate sand material shall be verified as part of the test pad for intermediate sand. Thickness measurements of the compacted intermediate sand will be documented and forwarded to the Construction QC Supervisor.</p> <ol style="list-style-type: none"> a. Approve lifts with an average compacted intermediate sand thickness greater than or equal to the specified compacted intermediate sand thickness. b. Add intermediate sand and retest lots with an average compacted intermediate sand lift thickness 	

111) INTERMEDIATE SAND: Intermediate sand shall be placed above all caissons, standard liners, and large liners. Intermediate sand shall be placed a minimum of two feet above caissons. In the case of liners placed without caissons, intermediate sand shall be placed to an elevation of at least nine feet above the base of the container for standard liners and 11.5 feet above the base of the container for large liners.

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Intermediate sand shall achieve a density of at least 85 percent of a standard Proctor.	<p>less than the specified compacted intermediate sand lift thickness.</p> <p>Perform at least one intermediate sand gradation and proctor test per 3,000 cubic yards (compacted) and anytime there is a change in material or borrow source. Conduct in-place density tests at the surface of the intermediate sand layer at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 10,000 square feet of a single lift. The test location shall be chosen on the basis of random numbers (described in Specification 12). Approve lots when:</p> <ol style="list-style-type: none"> Material is observed to be properly compacted throughout the lot; and Density tests performed meet compaction specifications. 	
112) BACKFILL COVER: After backfilling of voids between containers is complete and intermediate sand is placed (as needed), each lift of containerized waste shall be covered by at least one foot of compacted backfill cover material.	<p>Verify the mean elevation of the top of each backfill cover lift by installing grade poles, or other methods approved by the Engineering Manager. For each lift larger than 50 feet x 50 feet, survey the corners and at least one spot in the middle. For lifts less than 50 feet x 50 feet, a minimum of four grade poles, one in each direction, shall be used. Lifts larger than 50 feet x 50 feet may be segmented to areas 50 feet x 50 feet or less and elevation verified with the use of grade poles. The use of grade poles to verify the compacted thickness of the backfill cover material shall be verified as part of the test pad for backfill cover. Thickness measurements of the compacted backfill cover will be documented and forwarded to the Construction QC Supervisor.</p> <ol style="list-style-type: none"> Approve lifts with an average compacted backfill cover thickness greater than or equal to the specified compacted backfill cover thickness. Add backfill and retest lots with an average 	Review the QC documentation.

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Backfill cover for each lift shall achieve a density of at least 95 percent of a standard Proctor.	compacted backfill cover lift thickness less than the specified compacted backfill cover lift thickness.	
	<p>Perform at least one backfill cover proctor test per 3,000 cubic yards (compacted) and anytime there is a change in material or borrow source. Conduct in-place density tests at the surface of the backfill cover at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 10,000 square feet of a single lift. At least two tests will be performed per lift. The test location shall be chosen on the basis of random numbers (described in Specification 12). Approve lots when:</p> <ol style="list-style-type: none"> Material is observed to be properly compacted throughout the lot; and Density tests performed meet compaction specifications. 	
113) SET BACK OF WASTE: Maintain a distance of at least 10 feet between the inside toe of the runoff berm and the outside toe of the waste containers.	Perform a laboratory classification test on the backfill cover material at a rate of one test per 3,000 cubic yards (compacted), or change in backfill cover material type, or change in borrow source. The sample for this test will be taken from the backfill cover stockpile.	
	Initial waste set back approval shall measure the setback distance around the edge of the runoff berm at 100 foot intervals and place stakes for reference. The stakes may be removed after the first lift is completed. Record the inspection of the setback on the Daily Construction Report.	Review the QC documentation to confirm that the monthly inspections have been performed and properly documented.
	Inspect the waste setback on a monthly basis. Record findings on the Daily Construction Report.	
	Require removal of any waste necessary to maintain the required set back.	

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<p>114) SNOW REMOVAL: When waste material is to be placed and the work area is covered with snow, the snow must be removed.</p>	<p>Observe that snow is removed. Inspect the area for damage. Notify the Project Manager of deficiencies/damage and re-inspect after deficiencies/damage are corrected. Construction may not continue without corrective action. Record corrective action (where required) in the Daily Construction Report.</p>	<p>Review the QC documentation to verify that snow removal is being performed and documented and the area has been inspected.</p>
<p>115) COLD WEATHER PLACEMENT OF FLOWABLE SAND BACKFILL: The following requirements apply to placement of flowable sand backfill when the ambient air temperature is below 32 degrees °F:</p> <p>A. Backfill with frozen clods shall not be accepted for placement.</p> <p>B. The backfill stockpile shall be worked using heavy equipment prior to use.</p> <p>C. The minimum average spread diameter for the flowability tests shall be 8.75 inches.</p> <p>D. If backfill is observed to have frozen clods or does not meet the flowability specification, the backfill stockpile may be re-worked. Each inspection and test shall be repeated for re-worked material.</p>	<p>When the ambient air temperature falls below 32 °F:</p> <ol style="list-style-type: none"> a. Inspect the backfill stockpile to be used that day for any visible frozen clods. b. Observe working of the backfill stockpile. c. Perform a flowability test (ASTM D6103) on material from the backfill stockpile: <ol style="list-style-type: none"> 1) Collect a minimum of three representative samples from the backfill stockpile. 2) Test each sample using ASTM D6103. d. Record these actions and test results on the Daily Construction Report. 	<p>Review documentation and verify that the backfill stockpile is inspected, worked, and tested during cold weather conditions.</p>

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WORK ELEMENT – INTERIM RAD COVER PLACEMENT AND MONITORING

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
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<p>116) SCOPE: This work element applies to the Class A West embankment.</p> <p>117) DEFINITION: Interim rad cover is non-waste soil used to comply with the “uncovered radioactive waste” limit at RML UT 2300249, Condition 11. This material was historically referred to as “temporary cover” or “interim temporary cover”. Waste in closed containers may be stored on interim rad cover. If bulk waste is placed or stockpiled (temporarily placed) on interim rad cover, the affected area (the area occupied by the placed or stockpiled waste) shall no longer be considered to have interim rad cover on it.</p> <p>The following areas do not count against the “uncovered radioactive waste” limit at RML Condition 11 and do not require interim rad cover to be placed over them:</p> <ul style="list-style-type: none"> A. Containerized Waste Facility B. Large Component disposal areas C. CLSM pour areas that have been poured and covered. <p>Note: Areas where debris has been staged or formed for CLSM, but have not yet been poured and covered shall be counted against the “uncovered radioactive waste” limit.</p>		
<p>118) INTERIM RAD COVER MATERIAL: Interim rad cover shall be non-waste soil that is free of debris material.</p>	<p>Visually inspect interim rad cover soil for debris and document on the Daily Construction Report.</p>	

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<p>119) INTERIM RAD COVER PLACEMENT: Interim rad cover shall be a minimum of six inches thick in order for an area to be removed from the “uncovered radioactive waste” inventory. Thickness shall be evaluated through use of grade poles or survey. Contaminated equipment may be used to place interim rad cover.</p> <p>A commercial fixative product (i.e., polymer), magnesium chloride, or non-contact water may be applied, in accordance with the manufacturer’s instructions, to the surface of the interim rad cover to aid in dust control and erosion prevention. Erosion control blankets, mats, or fiber mulch may also be used, in accordance with the manufacturer’s instructions, for erosion prevention. DWMRC shall be notified at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch.</p>	<p>Survey at least the perimeter of the area covered and document. Document the thickness of the cover on the Daily Construction Report.</p>	<p>Periodically observe lift approval documentation.</p>
<p>120) OPERATIONAL CONTROLS: Interim rad cover shall be fenced, roped, or otherwise marked to identify as distinct from active waste placement areas. Traffic across interim rad cover shall be minimized. Haul roads are prohibited on interim rad cover.</p>		
<p>121) INSPECTIONS: Monthly, inspect interim rad cover for the presence of erosion gullies. If the inspection indicates that waste material is exposed due to erosion, the interim rad cover shall be repaired in that area within seven calendar days.</p>	<p>Perform monthly inspections and document on the Daily Construction Report.</p>	
<p>122) SURVEYS: Quarterly, perform an elevation survey on interim rad cover that is within two feet of the design top of debris waste elevation. Surveys shall be performed at the temporary and</p>	<p>Perform quarterly surveys and document.</p>	

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final settlement monument locations provided in Figure 2, within an 18 inch radius of the design monument location.		
123) REMOVAL: Interim rad cover may be removed. Soils used as interim rad cover may be used as fill for debris wastes. If used, erosion control blankets, mats, or fiber mulch may be left in place or removed, but either way must be placed and compacted as waste.		

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<p>124) SCOPE: This work element applies to the Class A West and 11e.(2) embankments. Because there is no open cell time limit for the 11e.(2) embankment, time limits within this specification do not apply there.</p>		
<p>125) TEMPORARY COVER MATERIAL: Temporary cover shall be native CL, ML, or CL-ML soils that are free of debris that could penetrate the radon barrier.</p>	<p>Perform laboratory classification tests at a rate of one test per lot prior to use of material. A lot is defined as a maximum of 5,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the Sampling Log.</p> <p>Visually inspect temporary cover soil and verify that it is free of debris. Record results on the Lift Approval Form.</p>	
<p>126) TEMPORARY COVER PLACEMENT: Temporary cover shall be placed within 15 years of the date of initial waste placement on each lift area. Top of waste elevations and grades are defined as those found on the approved engineering design drawings listed in Groundwater Quality Discharge Permit UGW450005. DWMRC shall be notified in writing (including email) at least 48 hours in advance of the start-up of temporary cover placement.</p> <p>Temporary cover shall be a minimum of 1 foot thick. Temporary cover may be over-built in order to achieve this thickness. Temporary cover shall be placed in accordance with Specifications 74 and 75.</p> <p>The edge of the temporary cover shall be marked with fencing, rope, snow fence, or equivalent marking to prevent heavy equipment travel on the temporary cover surface. Haul routes may traverse</p>	<p>Obtain documentation of DWMRC notification. Document lift area, location, thickness, and compaction on the Lift Approval Form.</p>	<p>Notify DWMRC (by email) that the final surface is ready for inspection. Provide QC with documentation of DWMRC inspection and approval.</p>

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<p>temporary cover, provided that the haul route does not travel over any interim settlement monuments and that the haul route is marked with fencing, rope, snow fence, or equivalent markings. Temporary cover may encroach into the offset for the run-off berm.</p> <p>A commercial fixative product, magnesium chloride, or clean water may be applied to the surface of the temporary cover to aid in dust control and erosion prevention. Contaminated water shall not be used for dust suppression on temporary cover. Erosion control blankets, mats, or fiber mulch may also be used, in accordance with the manufacturer's instructions, for erosion prevention.</p> <p>DWMRC shall be notified at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. If used, such erosion control materials shall be removed prior to radon barrier construction.</p>		
<p>127) PRE-FINAL COVER SETTLEMENT MONUMENTS: Prior to cover construction, Interim settlement monuments will be constructed on top of the waste. Interim settlement monuments shall consist of approximately 18-inch long #5 or greater rebar that is welded to a metal plate. The metal plate shall be approximately 18 inches square with a thickness of 3/16 inch to 1/4 inch. The metal plate shall be placed on the top of waste surface and secured by the temporary cover. Each monument shall be labeled, flagged, surveyed, and documented.</p>	<p>Obtain documentation of DWMRC notification. Document application and removal of erosion control materials on the Daily Construction Report.</p> <p>Inspect interim cover settlement monuments for compliance with the specification prior to installation.</p>	<p>Notify DWMRC at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. Provide QC with documentation of DWMRC notification.</p> <p>Perform a surveillance of interim settlement monument installation activities.</p>
<p>128) INTERIM SETTLEMENT MONUMENT</p>	<p>Perform and document a post-construction survey of</p>	<p>Verify that surveys have been performed and</p>

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<p>PLACEMENT: Interim settlement monuments shall be placed as close as practical to the locations of final cover settlement monuments identified in Figures 2 and 4. In addition, Interim settlement monuments shall be placed at the locations identified as “temporary cover settlement monuments” on Figure 2 and “additional final temporary cover monuments” on Figure 4.</p>	<p>the location of the pre-final cover settlement monuments.</p>	<p>documented.</p>
<p>129) SURVEY REQUIREMENTS: Surveys shall be performed with GPS or approved equivalent equipment. Tolerance shall be no more than ± 0.1 foot.</p>	<p>Operate survey equipment in accordance with the manufacturer’s recommendations. Verify equipment accuracy with a known benchmark.</p>	
<p>130) SURVEY INTERVAL: The interim settlement monuments shall be surveyed within 30 days of temporary cover installation. New monuments shall be surveyed again during the months of January, March, May, July, September, and November. After at least one year of data has been obtained for a monument, it shall be surveyed semi-annually during the months of May and November until final cover construction begins. Weather conditions at the time of the survey and a discussion of the potential for frost to be present shall be documented in the survey report.</p>	<p>Perform and document the required surveys. Provide survey data to the Engineering Manager.</p>	<p>Verify that interim settlement monument surveys are completed and documented as required.</p>
<p>131) INSPECTIONS: Monthly, inspect temporary cover for the presence of erosion gullies. If the inspection indicates that waste material is exposed due to erosion, the temporary cover shall be repaired in that area within seven calendar days.</p>	<p>Perform and document monthly inspections.</p>	<p>Verify monthly inspections were completed and documented.</p>
<p>Annually by July 1 of each year, maintain the temporary cover surface. Maintenance shall</p>	<p>Document maintenance activities. Document any areas requiring filling or re-grading.</p>	<p>Verify that annual temporary cover maintenance activities were completed and documented.</p>

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<p>consist of filling in and compacting any erosion gullies and, if necessary, re-grading to prevent ponding on the temporary cover.</p> <p>132) REPORTING: Survey data for interim settlement monuments shall be compiled and analyzed to evaluate total and differential settlement. This data and analysis shall be submitted to DWMRC with the annual as-built report.</p> <p>Review and analysis of interim settlement monument data will include the following:</p> <ul style="list-style-type: none"> • A drawing identifying the location of each interim settlement monument, • Graphical or tabular presentation of the incremental settlement for each monument (how much each monument has moved since the last set of readings), • Graphical or tabular presentation of the total settlement for each monument, • Graphical or tabular presentation of the time rate of settlement for each monument (to include both the overall rate from the first data for the monument, and the incremental rates for each period), • Graphical or tabular presentation of the differential settlement for each interim settlement monument with respect to the nearest adjacent interim settlement monument, and • A discussion about the general nature of the observed settlement, and any areas of the landfill that are behaving in an anomalous manner. 		

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<p>133) TRANSITION TO FINAL COVER: If distortion is less than 0.007 foot/foot between adjacent interim settlement monuments, and each interim settlement monument has at least one year's monitoring data; then final cover construction may proceed. The Engineering Manager shall make this evaluation from interim settlement data. If the criteria are met, a written report shall be prepared and forwarded to DWMRC at least seven calendar days prior to removing the interim settlement monuments. Final cover construction shall be completed within three years of interim settlement monument removal over that specific area.</p> <p>If an area is not approved for final cover construction by the end of the 16th year of the 18-year open cell period, an analysis of projected future distortions shall be performed and submitted to the DWMRC. The analysis shall evaluate potential settlement through the end of year 17 of the open-cell period, at a minimum. If the analysis indicates that the future distortions between any two adjacent monuments will be more than 0.007 foot/foot, then additional engineering analyses will be done and a plan to stabilize settlement prior to final cover construction provided to the DWMRC. The plan to stabilize settlement shall accomplish set goals prior to the open cell time limit.</p> <p>Immediately prior to placement of the first lift of radon barrier, the interim settlement monuments shall be removed and the temporary cover surface restored.</p> <p>Top of temporary cover elevations shall be at or</p>	<p>Obtain documentation of DWMRC notification at least seven calendar days prior to removing the interim settlement monuments.</p> <p>Inspect and document that all interim settlement monuments have been removed prior to final cover construction.</p> <p>Survey and document the top of temporary cover</p>	<p>Verify that QC has obtained documentation of DWMRC notification.</p> <p>Verify that interim settlement monuments have been removed.</p> <p>Verify that the temporary cover surface does not</p>

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below design elevations. Additional clean debris-free soil material shall be placed; or excess temporary cover material shall be cut, as needed.	surface on a 50 foot grid and at key points (i.e., embankment break lines) to confirm that the design elevations are not exceeded.	exceed design elevations.
When placing clean debris-free soil material for this purpose, the soil shall be placed in lifts with a compacted average thickness not exceeding 12 inches and compacted to 90 percent of a standard Proctor. If an area has settled more than 12 inches, bulk waste may be placed in accordance with the applicable work elements and specifications of this manual, so long as at least 1 foot of temporary cover is in place prior to radon barrier construction.	Document lift thickness and compaction for any temporary cover material placed to bring the temporary cover surface to design elevations.	Verify that documentation is complete.
DWMRC shall be notified at least 48 hours in advance of the start-up of temporary cover removal in previously placed areas.	Obtain documentation of DWMRC notification. Document the lift area and location on the Daily Construction Report.	Notify DWMRC at least 48 hours in advance of temporary cover removal. Provide QC with documentation of DWMRC notification.

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WORK ELEMENT - RADON BARRIER BORROW MATERIAL

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>134) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.</p>		
<p>135) CLEARING AND GRUBBING: Remove vegetation, debris, organic, or deleterious material from areas to be used for borrow. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.</p>	<p>Inspect the area once clearing and grubbing has been completed. Record observations and corrective action (where required) on the Daily Construction Report.</p>	<p>Verify that the clearing and grubbing has been inspected and documented by QC.</p>
<p>136) MATERIAL--NATURAL CLAY MIXTURE: Satisfactory material shall be defined as CL and ML soils based on the Unified Soil Classification with at least 85 percent passing the No. 200 sieve (silt and clay), a plasticity index (PI) between 10 and 25, and a liquid limit (LL) between 30 and 50.</p>	<p>Perform laboratory classification tests (ASTM D 2487) at a rate of one test per lot prior to use of material in the radon barrier. A lot is defined as a maximum of 5,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the Sample Log.</p>	<p>Verify that the frequency of laboratory tests is in compliance with the specification.</p>
<p>137) PROTECTION: The borrow material will be handled in such manner as to prevent contamination with radioactive waste material or other deleterious material. Acceptable material may contain up to five percent additional rocks (less than or equal to one inch) and sand above the content found in the classification test.</p>	<p>Visually check radon barrier materials for contamination by foreign materials in accordance with ASTM D2488. Remove or rework clays that have been contaminated above the specified requirements. Document corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify that the radon barrier is being inspected for contaminants and that the inspection and corrective actions (if required) are properly documented.</p>
<p>138) PROCESSING: These procedures may be used to provide suitable material for construction of the radon barrier.</p> <p>A. If used, apply deflocculant at a rate determined by the Engineering Manager.</p>	<p>Measure the size of the mixing areas and verify that the application rate of the deflocculant is equal to or greater than the rate determined by the Engineering Manager. Record the size of the mixing areas and the amount of deflocculant applied on the Embankment Construction Lift Approval Form.</p>	<p>Verify that the size of the mixing areas and the amount of deflocculant applied has been properly documented.</p>

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B. Mix the deflocculant thoroughly into the soils by tilling, or similar action.	Observe the mixed clay and notify the Project Manager of areas which are adequately mixed.	Verify that the clay is being inspected correctly and documented by QC.

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WORK ELEMENT - RADON BARRIER TEST PAD

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<p>139) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.</p>		
<p>140) NOTICE OF TEST PAD CONSTRUCTION: The radon barrier test pad plan shall be approved by the DWMRC. The radon barrier test pad plan shall be provided to the DWMRC at least 14 calendar days prior to test pad construction. If DWMRC has not provided approval or deficiency notification prior to the end of 14 calendar days, construction may proceed as proposed in the test pad plan.</p>	<p>Obtain documentation confirming that the test pad plan has been approved by the DWMRC or the 14 calendar day period has ended.</p>	<p>Verify that the test pad plan has been provided to the DWMRC at least 14 calendar days prior to construction of the test pad. Provide QC with documentation of DWMRC approval or documentation that the 14 calendar day period has expired.</p>
<p>The DWMRC shall be notified 48 hours in advance of the start-up of test pad construction.</p>	<p>Obtain documentation confirming that the DWMRC has been notified as required.</p>	<p>Notify the DWMRC at least 48 hours in advance of the start-up of test pad construction. Provide QC with documentation of DWMRC notification.</p>
<p>141) TEST PAD(S): A test pad with minimum dimensions of 60 feet by 75 feet will be constructed using the procedure proposed for construction of the radon barrier.</p>	<p>Observe the construction of test pads. Measure test pads to ensure that they are constructed to the size indicated. Record the test pad size on the Embankment Construction Lift Approval Form.</p>	<p>Observe the construction of the test pads. Verify that the test pad has been measured and is properly documented.</p>
<p>Prior to use of manually operated compaction equipment, a small test pad with minimum dimensions of five feet by five feet (sized appropriately for the equipment used) will be constructed. The purpose of this small test pad is to establish equipment and procedures for construction of radon barrier in locations where large equipment is not practical (e.g. repairs). If manually operated compaction equipment is not used on the project, a small test pad is not required.</p>	<p>The large test pad shall be divided into three lots per lift (approximately 1,500 square feet per lift). Each lift of the small test pad shall equal a lot.</p>	
<p>A new radon barrier test pad shall be constructed each time there is a change in specifications, construction procedures, unified soil classification,</p>		

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<p>or types of equipment.</p> <p>Radon barrier test pads are to be constructed and tested in accordance with the following specifications:</p> <p>A. Prior to compaction, conduct at least one classification and gradation test for each test pad.</p> <p>B. Place the clay in at least three lifts with the first lift uncompacted thickness not exceeding twelve inches. Remaining lifts shall have a loose material thickness not exceeding nine inches for each lift.</p> <p>C. The clay material will have a dry clod size less than or equal to one inch.</p> <p>D. The clay is to be placed and compacted by equipment proposed for use during construction of the radon barrier.</p> <p>E. The lifts of clay shall be bonded by providing a rough upper surface on the underlying layer of radon barrier. The surface should have changes in grade of approximately one inch or more at a rate of two or more per linear foot.</p>	<p>Conduct classification and gradation tests (as described in Appendix B) at a rate of one of each type of test per test pad.</p> <p>Measure the lift thickness at a rate of one test per lot. Record thickness on the Embankment Construction Lift Approval Form.</p> <p>Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one inch. Notify the Project Manager to have operations remove clods greater than one inch. Record inspection of the dry clod size on the Embankment Construction Lift Approval Form and re-inspect the uncompacted lift if necessary. Record any corrective actions performed on the Daily Construction Report.</p> <p>Record type of equipment used, and number of passes on the Embankment Construction Lift Approval Form.</p> <p>Perform a visual inspection to verify that there are adequate changes in grade. Any areas of concern shall be verified by placing a straight edge at least two feet long on the surface and counting the number of points approximately one inch or more below the straight edge. Notify the Project Manager of any deficiencies. Re-inspect after the Project Manager has corrected</p>	<p>Verify the frequency of tests and compliance of test results.</p> <p>Verify that the number of lifts and lift thicknesses has been documented. Verify that the clod size inspection has been performed and documented for each uncompacted lift thickness.</p> <p>Verify that the dry clod size inspection has been performed and documented, including corrective actions as necessary.</p> <p>Perform a minimum of one visual inspection per test pad.</p> <p>Verify the frequency of measurements and compliance of test results.</p>

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	deficiencies.	
F. The clay is to be compacted to at least 95 percent of a standard Proctor with moisture content between one-half a percentage point below optimum and five percentage points over optimum. Compaction of the large test pad is to be accomplished by at least four passes of suitable compaction equipment.	<p>Conduct in-place moisture-density tests at a rate of one test per lot per lift. The test location shall be chosen on the basis of random numbers (described in Specification 12). Record the test result on the Field Density Test form.</p> <ol style="list-style-type: none"> Approve lots which meet the specified moisture and compaction. Notify the Project Manager of lots not meeting the specified moisture and compaction to have the areas reworked. Retest (moisture/density and permeability) lots after rework has been completed. Any additional work under b. shall be included in the test pad construction method. 	Review documentation and verify the frequency of tests and compliance of test results.
G. The clay is to be constructed to provide a permeability of less than or equal to the specified permeability as shown on the approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005. Permeability testing on the bottom lift will be performed at the surface. Permeability on the second lift will be performed greater than or equal to two inches below the surface. Permeability on the third lift will be performed greater than or equal to four inches below the surface.	<p>Conduct in-place permeability tests at a rate of one test per lot per lift. The permeability test shall be run in close proximity to the moisture-density test. Record the test result on the Field Permeability Test form.</p> <ol style="list-style-type: none"> Approve lots that meet the specified permeability. Notify the Project Manager of lots not meeting the specified permeability to have the areas reworked. Retest (moisture/density and permeability) lots after rework has been completed. Any additional work under b. shall be included in the test pad construction method. 	Verify the frequency of tests and compliance of test results.
H. The procedures used to construct the test pad shall be reviewed and approved by a Utah licensed Professional Engineer.	Provide the Utah licensed Professional Engineer with copies of the documentation for the test pad for review and approval.	Verify that proper approval has been obtained for the test pad and that the necessary construction procedure documents are in place for use during radon barrier construction.
I. The test pad certification report shall be approved by the DWMRC prior to using the new test pad construction method. However, if	Obtain documentation confirming that the test pad certification report has been approved by the DWMRC or the 14 calendar day period has ended.	Verify that the test pad certification report has been provided to the DWMRC. Provide QC with documentation of DWMRC approval or documentation that the 14 calendar day period has expired.

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the DWMRC has not provided approval or deficiency notification prior to the end of 14 calendar days from the time the certification report was submitted, construction may proceed using the new construction method.

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142) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.		
143) NOTICE OF COVER CONSTRUCTION: The DWMRC shall be notified of start-up for each phase of cover construction.	Obtain documentation of DWMRC notification.	Notify the DWMRC of start-up for each phase of cover construction. Provide QC documentation of DWMRC notification.
144) PROJECT AREA: Radon barrier projects shall have a minimum total area of 300,000 square feet, unless otherwise approved in advance, in writing by DWMRC. Radon barrier projects may continue over more than one construction season, so long as the specifications for cold weather placement and spring start-up are met (Specifications 156 and 157). A radon barrier project may consist of any number of lift areas. The project area shall be documented in plan drawings.		
145) LIFT IDENTIFICATION: Each lift shall be given a unique lift identification number for testing and surveying purposes.	Assign a lift identification number to each lift. Use the lift identification number to identify all paper work for that lift.	Verify that a lift identification number has been assigned to each lift. Verify that the lift identification number is used on all paper work for that lift.
146) PLACEMENT: The radon barrier will be prepared, placed and compacted using the same type of equipment and mixing and compacting procedures that were approved in the test pad (Specification 141).	Observe the radon barrier placement. Record the equipment used to place the radon barrier, along with any corrective actions (where required) on the Daily Construction Report.	Verify the equipment used to construct the radon barrier has been documented and that it is the same type of equipment used to construct the test pad.
147) LIFT BONDING: The lifts of clay shall be bonded by providing a rough upper surface on the underlying layer of radon barrier. The surface should have changes in grade of approximately one inch or more at a rate of two per linear foot.	Perform a visual inspection to verify that there are adequate changes in grade. Any areas of concern shall be verified by placing a straight edge at least two feet long on the surface and counting the number of points approximately one inch or more below the straight edge. Notify the Project Manager of any deficiencies. Re-inspect the surface after corrective actions have been completed. Document any deficiencies and	Verify the frequency of measurements and compliance of test results.

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	corrective actions taken on the Daily Construction Report.	
<p>148) LIFT THICKNESS: The first lift of material shall have an uncompacted thickness of no greater than 12 inches. For the remaining lifts, the loose lift thickness shall not exceed the lesser of the lift thickness used to construct the test pad or nine inches.</p> <p>A. Thickness for the lift will be established by installing grade poles on at least a 70-foot grid and at all control points (at a minimum, each corner of the area; also at break lines). The grade poles must not be installed deeper than one inch into the underlying clay liner. The grade poles must be marked at the appropriate depth to establish the grade. After the grade for the lift has been checked and approved by QC personnel, the grade poles shall be removed.</p>	<p>Verify that the required grading tolerance is achieved as follows:</p> <ol style="list-style-type: none"> Ensure that the required frequency for placement of grade poles has been met. Compare soil level with the marked level on the grade poles. Visually check between poles for high or low spots. Define out of specification areas and notify the Project Manager to rework those areas. Review areas reworked and approve areas meeting criteria. Continue "b" through "d" above until all areas meet criteria. Indicate areas meeting criteria in the Embankment Construction Lift Approval Form. 	<p>Verify the frequency of measurements and compliance of test results.</p>
- OR -	- OR -	
<p>B. Survey to determine lift thickness. Survey equipment shall have a tolerance no more than ± 0.1 foot.</p>	<ol style="list-style-type: none"> Verify survey equipment is within a tolerance of ± 0.1 foot, Verify correct set-up and operation of equipment, Document survey results on a survey report. 	
<p>The clay material shall have a dry clod size less than or equal to one inch.</p>	<p>Inspect the loose clay material during the unloading and spreading process for each uncompacted lift to ensure any dry clods that are present are less than or equal to one inch. Notify the Project Manager to have operations remove clods greater than one inch. Record inspection of the clod size on the Embankment Construction Lift Approval Form and re-inspect the uncompacted lift. Record any corrective actions</p>	

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<p>149) KEYING-IN: Segments of cell radon barrier constructed at times more than 30 days apart than each other shall be keyed-in to each other by one of the following methods:</p> <p>A. Key-in vertical steps no greater than nine inches and at least twice as wide as they are high.</p> <p style="text-align: center;">- OR -</p> <p>B. Slope the full thickness of old radon barrier at a maximum slope of 5:1.</p> <p>The surface shall be maintained in accordance with Specification 154.</p>	<p>performed on the Daily Construction Report.</p> <p>Verify that the new liner has been properly keyed-in to the existing liner. Record deficiencies on the Embankment Construction Lift Approval Form.</p>	<p>Verify that the keying-in of the liner has been documented.</p>
<p>150) COMPACTION: Radon barrier material will be compacted to at least 95 percent of standard Proctor with moisture content between one-half a percentage point below optimum and five percentage points over optimum.</p>	<p>Conduct in-place moisture-density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 500 cubic yards (compacted) of a single lift. The test location shall be chosen on the basis of random numbers (described in Specification 12).</p> <p>a. Approve lots which meet the specified moisture and compaction.</p> <p>b. Rework and retest lots not meeting the specified moisture or compaction.</p> <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 3,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the Sampling Log.</p>	<p>Visually observe at least one in-place moisture-density test per project area. Verify that the tests are being performed at the correct frequency and that the documentation is being completed.</p>
<p>151) PERMEABILITY: The radon barrier shall</p>	<p>Conduct in-place permeability tests at a rate of one test</p>	<p>Visually observe one lift being compacted per</p>

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<p>have an in-place permeability of less than or equal to 1×10^{-6} cm/sec for the bottom layer. The radon barrier shall have an in-place permeability of less than or equal to 5×10^{-8} cm/sec for the final top foot.</p>	<p>per lot and record the results on the Field Permeability Test form. A lot is defined as 2,000 compacted cubic yards of 1×10^{-6} cm/sec radon barrier or 5×10^{-8} cm/sec radon barrier. The permeability test shall be run within five linear feet of a moisture-density test location.</p> <ol style="list-style-type: none"> Approve lots which meet the specified permeability. Notify the Project Manager of lots not meeting the specified permeability to have the areas reworked. Retest (moisture/density and permeability) lots after rework has been completed. Restore all test areas to assure no leaks. 	<p>construction season.</p>
<p>152) LAYER THICKNESS: For the CAW Embankment, the bottom (1×10^{-6} cm/sec permeability) layer shall be at least 1.0 foot thick. For the 11e.(2) embankment top slopes, the bottom (1×10^{-6} cm/sec permeability) layer shall be at least 3.0 feet thick. For the 11e.(2) embankment side slopes, the bottom (1×10^{-6} cm/sec permeability) layer shall be at least 2.5 feet thick. For the CAW and 11e.(2) embankments, the top (5×10^{-8} cm/sec permeability) layer shall be at least 1.0 foot thick.</p>		
<p>153) TRANSITIONS BETWEEN RADON BARRIERS WITH DIFFERENT SPECIFIED PERMEABILITIES: The radon barrier with the higher permeability (i.e. the bottom radon barrier) shall be final graded from design elevation to 0.4 feet below design elevation. Survey on a 50 foot grid and key points (i.e., embankment break lines).</p>	<p>Survey the radon barrier surface on a 50 foot grid and at key points. Final survey measurements will be documented and provided to the QC Supervisor and Quality Assurance.</p>	<p>Review the final survey data. Verify the frequency of the survey points.</p>
<p>154) RADON BARRIER DRYING PREVENTION: To prevent the radon barrier from drying, water will be applied to the clay</p>	<p>Observe the liner surface for drying. Notify the Project Manager of any desiccation cracks larger than one-fourth inch wide and three-inches deep in the clay</p>	<p>Verify that the liner is being inspected correctly and the inspection documented. Notify the DWMRC of non-conformance items, as required.</p>

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<p>surface on an as needed basis or the radon barrier will be covered with six inches of loose clay. Finished radon barrier shall be covered with 12 inches the next design layer, or six inches of loose clay within 30 days of completion. Unfinished radon barrier shall be covered with six inches of loose clay within 30 days of the last activity for the lift. Desiccation cracks larger than one-fourth inch wide and three-inches deep in the radon barrier will be reported to the DWMRC and will be documented as a non-conformance item when discovered.</p>	<p>liner. Retest reworked/repaired areas in accordance with Specification 150. Record corrective actions taken (where required) on the Daily Construction Report.</p>	
<p>155) SNOW REMOVAL: When radon barrier material is to be placed and the work area is covered with snow, the snow must be removed without damaging approved radon barrier.</p>	<p>Observe that snow is removed. Inspect radon barrier for damage. Notify the Project Manager of deficiencies/damage. Re-inspect after the Project Manager has corrected deficient/damaged areas. Record corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify that snow removal is being documented and the radon barrier had been inspected.</p>
<p>156) COLD WEATHER PLACEMENT OF RADON BARRIER: For purposes of this Manual, “frozen” is defined as a soil temperature of less than or equal to 27°F. Radon barrier shall not be placed above frozen material. In addition, no frozen material shall be processed or placed.</p>	<p>As needed, observe the area where radon barrier is to be placed. If frozen material is observed, cease placement of radon barrier. If frozen material is suspected, measure soil temperature. Record the stopping of placement in the Daily Construction Report.</p>	
<p>If the air temperature has dropped below 32°F since the last lift of radon barrier was approved, one of the following three scenarios apply:</p>	<p>Review ambient air temperature records as measured at the site meteorological station. Document status of radon barrier cover placement on the Daily Construction Report. Measure radon barrier temperature when triggered under B.2. of this specification at the design frequency. Clay temperature shall be measured between 6:00 AM and 8:00 AM on the day that radon barrier will be placed. Temperature measurements shall include a location that is most likely to be coldest; i.e., if there is a portion of the</p>	
<p>A. If less than 30 days have passed since the date of lift approval and the last lift of radon barrier has been covered since the approval date with at least nine inches of loose clay or six inches of compacted clay, then the cover clay may be worked with no additional testing</p>		

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SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>of the lower approved lift.</p> <p>B. If less than 30 days have passed since the date of lift approval and the last lift of radon barrier has not been covered with at least nine inches of loose clay or six inches of compacted clay, then:</p> <ol style="list-style-type: none"> 1. Perform spring start-up testing as discussed below; or 2. Measure the radon barrier temperature approximately one inch beneath the surface at a frequency of one measurement per lot (defined as no more than 100,000 square feet). If the temperature one inch beneath the surface is greater than 27°F, re-roll the surface with one pass of the same type of construction equipment (i.e., a compactor for intermediate lifts or a smooth drum roller for the final surface) and continue with radon barrier construction. If the temperature one inch beneath the surface is less than or equal to 27°F, re-work and re-test density and permeability of the affected area after the clay temperature has risen above 27°F. <p>C. If more than 30 days have passed since the date of lift approval, perform spring start-up testing.</p>	<p>radon barrier that is shaded or at a low point. To ensure a stable reading, the temperature probe shall be left in place for at least two minutes prior to taking the reading</p> <p>If the initial radon barrier temperature measurement is less than or equal to 27°F, the affected area may be resampled before 8:30 AM the same day as follows:</p> <ol style="list-style-type: none"> a. Measure the radon barrier temperature at a frequency of one measurement per lot (defined as no more than 10,000 square feet). b. Lots where the temperature is greater than 27°F do not require rework; except that the lot where the initial temperature less than or equal to 27°F was measured shall be reworked regardless of resampling results. 	<p>Verify that radon barrier is tested (and the testing documented) during cold weather conditions.</p>
<p>In addition, the final lift of 5×10^{-8} cm/sec radon barrier requires that the next design layer be placed over the radon barrier prior to the end of the work day when ambient temperatures will drop below 32 degrees Fahrenheit. If this protective cover is not applied prior to freezing conditions, an</p>	<p>Perform an additional density test and permeability test on 5×10^{-8} cm/sec final surface that has been exposed to overnight freezing conditions prior to placement of the next design layer. If passing test results are achieved, but it is not possible to cover all of the exposed radon barrier material with the next design</p>	

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - RADON BARRIER PLACEMENT

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>additional density test and permeability test shall be performed directly prior to covering the radon barrier final surface with the next design layer. This process must be repeated whenever any final surface material is not covered with the next design layer prior to overnight freezing conditions.</p>	<p>layer prior to the end of the workday, testing must be repeated for the exposed materials. This testing may be performed outside of the approved lift area so long as the area tested is representative of the clay in the approved lift area (i.e., was constructed at the same time and with the same method).</p>	
<p>157) SPRING START-UP: See Specification 156 for situations that trigger this specification.</p>	<p>Perform density and permeability testing at the frequencies outlined for radon barrier construction above. This testing may be performed outside of the approved lift area so long as the area tested is representative of the clay in the approved lift area (i.e., was constructed at the same time and with the same method). Moisture testing is not required for spring start-up.</p> <ol style="list-style-type: none"> Approve lots that meet specification. The protective cover lift may be worked in place and tested to become the next lift of radon barrier. For lots that do not meet specification, test the surface at successively deeper nine inch increments until a passing lift is found; remove all failing lots; re-work all failing lots; and re-test. 	
<p>158) CONTAMINATION OF RADON BARRIER: The radon barrier material shall not become contaminated with radioactive soils or debris during construction. The in-place clay may contain up to five percent additional rocks (less than or equal to one inch) and sand above the content found in the classification test.</p>	<p>Document that repairs are completed to the same level of effort as required by the approved test pad for radon barrier construction.</p> <p>Visually check radon barrier for contamination by foreign materials in accordance with ASTM D2488. Remove or rework clays which have been contaminated above the specified requirements. Document corrective actions (where required) on the Daily Construction Report.</p>	<p>Verify that the radon barrier is being inspected for contaminants and that the inspection and corrective actions (if required) are properly documented</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - RADON BARRIER PLACEMENT

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>159) FINAL GRADING: Final grading shall be from design elevation to 0.2 feet above design elevation.</p>	<p>Survey the final grade surface of the radon barrier on a 50 foot grid and at key points (i.e., embankment break lines). Final survey measurements will be documented and provided to Quality Assurance.</p>	<p>Review the final survey data. Verify the frequency of the survey points.</p>
<p>160) EROSION CONTROL FOR EXPOSED SOIL: If DWMRC-approved final elevation 5×10^{-8} cm/sec radon barrier soil surfaces are not covered by the next design layer within 30 days of lift approval, the following erosion control repair measures shall apply.</p> <p>Monthly, inspect exposed radon barrier soil surfaces for evidence of erosion. Rivulet or gullied areas wider than six inches or deeper than six inches require maintenance to fill the rivulet or gully and restore the area to design elevation. Soils imported as fill shall meet the requirements of Specification 136. Maintenance shall be performed within 30 calendar days when needed.</p> <p>Erosion control blankets, mats, or fiber mulch may be used, in accordance with the manufacturer's instructions, for erosion prevention.</p> <p>DWMRC shall be notified at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. If used, such erosion control materials shall be removed prior to filter zone construction.</p>	<p>Perform monthly inspections. Document the inspection as well as associated maintenance activities on the Daily Construction Report.</p> <p>Obtain documentation of DWMRC notification.</p>	<p>Review documentation to verify that monthly inspections have been performed.</p> <p>Notify DWMRC at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. Provide QC with documentation of DWMRC notification.</p>
<p>161) RADIOLOGICAL SAMPLING FOR EXPOSED SOIL: If DWMRC-approved final elevation 5×10^{-8} cm/sec radon barrier soil surfaces are not covered by the next design layer within 30 days of final approval, the area shall be either:</p>	<p>Coordinate sampling and analysis with environmental personnel. Attach a copy of the release report to the lift approval documentation.</p>	

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - RADON BARRIER PLACEMENT

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>A. sampled and radiologically released in accordance with the Environmental Monitoring Plan; or</p> <p>B. have a minimum of six inches of clay removed and replaced prior to placement of the next design layer. Under this option, no environmental sampling is required.</p>		
<p>162) HEAVY EQUIPMENT ON RADON BARRIER: Heavy equipment travel will be minimized on top of the finished radon barrier. Heavy equipment will not be operated on saturated radon barrier.</p>	<p>Observe work on radon barrier. Notify the Project Manager of problems with equipment on the radon barrier. Re-inspect radon barrier and record corrective actions taken (where required) on the Daily Construction Report.</p>	<p>Verify that the work is being inspected.</p>
<p>163) DWMRC APPROVAL: The DWMRC shall approve documentation associated with completed radon barrier. Documentation shall include all QC and QA records associated with construction, as well as photographs of the completed surface. In addition, 48 hour notification shall be provided to the DWMRC prior to placement of the next design layer over the finished radon barrier. <i>EnergySolutions</i> may proceed with placement of the next design layer 48 hours after DWMRC notification if the DWMRC has not inspected and has not notified the Engineering Manager of its intent to inspect the radon barrier surface.</p>	<p>Notify Quality Assurance that the radon barrier is ready for inspection by the DWMRC. Obtain written authorization on the Liner Inspection Form from Quality Assurance that the radon barrier has been inspected. Obtain documentation of DWMRC notification. Confirm DWMRC approval of the radon barrier documentation.</p>	<p>Provide written approval of the radon barrier. Notify the DWMRC that the radon barrier is ready for inspection. Provide QC with documentation of DWMRC notification.</p>

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - FILTER ZONE

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
164) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.		
165) TYPE B FILTER ZONE PERMEABILITY: The type B filter zone rock on the Class A West embankment will have a minimum permeability of 3.5 cm/sec. The filter zone rock on the 11e.(2) embankment will have a minimum hydraulic conductivity of 42 cm/sec.	Perform permeability testing at a rate of one test per 10,000 cubic yards placed. Record the location of all samples in the "Sampling Log". a. Approve rock for use in the filter zone which meets the specified gradation. b. Rock not meeting the specified gradation cannot be used.	Verify the frequency of laboratory tests and compliance of test results.
166) GRADATION: Class A West and 11e.(2) embankment rock gradation shall be as specified on currently approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005.	For Type B filter zone rock, if material is to be stockpiled, perform gradation testing at a rate of one test per 10,000 cubic yards stockpiled. If Type B filter zone rock material is transferred directly to the cell from the production plant, perform at least one gradation test per source per day material is placed, or at least one test per 10,000 cubic yards. For Type A filter zone rock, perform gradation testing at a rate of one test per 10,000 cubic yards. For all of these, a minimum of four tests is necessary per embankment. In addition, perform a minimum of one test per change in soil type by ASTM D2488. Record the location of all samples in the Sampling Log. If any deficiencies are identified in gradation testing, notify the Project Manager to have operations rework the material. After reworking (if necessary), retest the material and record corrective actions (where required) in the Daily Construction Report.	Verify the frequency of laboratory quality control tests and compliance of test results.
167) PLACEMENT: Filter zone material will be placed over the radon barrier. The thickness of the filter zone layer for the Class A West and 11e.(2) embankments shall be as specified on currently	Observe the placement of the filter zone material. Ensure that the filter zone is uniform in appearance with no soil fines or rock concentrated in localized areas. If the filter zone is not uniform in appearance,	Review documentation and verify that QC personnel observe the placement of the filter zone material such that it is uniform in appearance.

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - FILTER ZONE

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005. Filter zone material shall be handled in such a manner as to prevent contamination from waste material and segregation of finer materials.</p>	<p>notify the Project Manager to have operations evenly distribute the filter zone material. Re-inspect the filter zone material and record corrective actions (where required) in the Daily Construction Report.</p>	
<p>168) SNOW REMOVAL: When filter zone material is to be placed and the work area is covered with snow, the snow must be removed.</p>	<p>Observe that snow is removed. Inspect the filter zone for damage. Notify the Project Manager of any deficiencies/damage. Re-inspect the filter zone and record corrective actions (where required) in the Daily Construction Report.</p>	<p>Verify that snow removal is being documented and the filter zone has been inspected.</p>
<p>169) FINAL GRADING: Thickness for the lift will be established by installing grade poles on at least a 50' grid and at all control points. The grade poles shall consist of PVC pipe (approximately ½-inch diameter) with surveyor's ribbon (or other distinguishable markings) attached to the appropriate lift thickness. The poles shall be held in place by placing the filter rock adjacent to the base of the grade pole to secure it in a vertical position (long axis of the grade pole perpendicular to the radon barrier surface). With the grade pole marked at the appropriate thickness and secured at the appropriate locations, the filter rock may be placed throughout the project area. The base of the grade poles shall rest on the surface of the radon barrier and therefore will not damage the radon barrier surface. After the grade has been checked and approved by QC personnel, the grade poles shall be removed from the filter zone.</p>	<p>Verify that the grade poles are marked at the appropriate depth to establish grade for the layer that will be placed. Observe the installation of some of the grade poles to ensure that the installation method has been followed and verify that the grade poles have not penetrated or damaged the surface of the radon barrier.</p> <p>Verify the required grade is achieved at all control points throughout the placed filter rock in the project area. Confirm that the in-place thickness of the rip rap material is between 90 percent and 125 percent of the design thickness. Rework and re-verify areas not meeting the specified grade. Ensure all grade poles have been removed following verification of grade. Document all inspections and corrective actions, where required, on the Daily Construction Report.</p>	<p>Review documentation for final grading.</p>

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - SACRIFICIAL SOIL PLACEMENT

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
170) SCOPE: This work element applies to the Class A West embankment.		
171) PLACEMENT: Sacrificial soil will be placed over the filter zone as specified on currently approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005. Sacrificial soil shall be handled in such a manner as to prevent contamination from waste material and segregation of finer materials.	Observe the placement of the sacrificial soil. Ensure that fines are not concentrated in localized areas. If fines are concentrated in localized areas, the Project Manager shall be directed to evenly distribute the fines or to remove them. Record corrective actions (where required) in the Daily Construction Report.	Verify that QC personnel observe the placement of the sacrificial soil such that fines are not concentrated in localized areas.
172) GRADATION: Gradation of the sacrificial soil shall be as specified on the currently approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005. Gradation shall be determined prior to placement of the sacrificial soil.	<p>If material is to be stockpiled, perform gradation testing at a rate of one test per 2,500 cubic yard stockpile. If material is transferred directly to the cell from the production plant, perform at least one test per source per day material is placed, or at least one test per 2,500 cubic yards. In addition, perform a minimum of one test per change in soil type by ASTM D 2488. Record the location of all samples in the Sampling Log.</p> <ol style="list-style-type: none"> a. Approve material for use as sacrificial soil which meets the specified gradation. b. Material not meeting the specified gradation cannot be used. 	Verify the frequency of laboratory tests and compliance of test results.
173) SNOW REMOVAL: When sacrificial soil is to be placed and the work area is covered with snow, the snow must be removed.	Observe that snow is removed. Notify the Project Manager of any deficiencies. Construction may not continue without taking corrective action to remove the snow. Re-inspect and record corrective actions (where required) in the Daily Construction Report.	Verify that snow removal is being documented as per DWMRC requirement.
174) FINAL GRADING: Thicknesses for the lift will be established by installing grade poles on at least a 50 foot grid and at all control points. The grade poles must be marked at the appropriate depth to establish grade. After the grade has been checked and approved by QC personnel, the grade	Verify the required grade is achieved at all control points. Confirm that the in-place thickness of the sacrificial soil is between 90 percent and 125 percent of the design thickness. Notify the Project Manager of areas not meeting the specified grade. Re-verify after rework has been completed. Document all inspections	Review the documentation for final grading.

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - SACRIFICIAL SOIL PLACEMENT

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
poles shall be removed.	and corrective actions, where required, on the Daily Construction Report.	

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - ROCK EROSION BARRIER

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
175) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.		
176) GRADATION: Gradation of the rock (top slope and side slope) shall be as specified on the currently approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005.	<p>Perform gradation testing, in accordance with ASTM D5519 or C136, at a rate of one test per 10,000 cubic yards with a minimum of four tests per embankment. Record the location of all samples in the Sampling Log.</p> <p>If any deficiencies are identified in gradation testing, notify the Project Manager to have operations rework the material. After reworking (if necessary), retest the material and record corrective actions (where required) in the Daily Construction Report.</p>	Verify the frequency of laboratory quality control tests and compliance of test results.
177) PLACEMENT: Rock erosion material will be placed over the filter zone. Thickness of rock erosion barrier shall be 18 inches inside the centerline of the perimeter ditch and 12 inches outside the centerline of the perimeter ditch as described in the currently approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005. Rock erosion material shall be handled in such a manner as to prevent contamination from waste material and segregation of finer materials.	Observe the placement of the rock. Ensure that soil fines are not concentrated in localized areas. If soil fines are concentrated in localized areas, notify the Project Manager to have operations evenly distribute the fines or to remove them. Re-inspect after the Project Manager makes changes. Record corrective actions (where required) in the Daily Construction Report.	Verify that QC personnel observe the placement of the filter zone material such that soil fines are not concentrated in localized areas.
178) SNOW REMOVAL: When rock erosion barrier material is to be placed and the work area is covered with snow, the snow must be removed.	Observe that snow is removed. Inspect the rock erosion barrier for damage. Notify the Project Manager of any deficiencies. Re-inspect and record corrective actions (where required) in the Daily Construction Report.	Verify that snow removal is being documented DWMRC and the rock erosion barrier has been inspected.
179) FINAL GRADING: Thickness for the lift will be established by installing grade poles on at least a 70 foot grid and at all control points or by GPS survey. The grade poles shall consist of PVC pipe (approximately one-half inch diameter) with	Verify the required grade is achieved at all control points. Confirm that the in-place thickness of the sacrificial soil is between 90 percent and 125 percent of the design thickness. Notify the Project Manager of areas not meeting the specified grade. Re-verify after	Review the documentation for final grading.

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - ROCK EROSION BARRIER

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>surveyor ribbon (or other distinguishable markings). The grade poles must be marked at the appropriate depth to establish grade. After the grade has been checked and approved by QC personnel, the grade poles shall be removed.</p> <p>180) NOTICE OF COVER CONSTRUCTION: Provide written notice of the completion of cover construction to the DWMRC within 30 days of completion of each phase of cover construction in the "cut and cover" operation.</p>	<p>rework has been completed. Document all inspections and corrective actions (where required) on the Daily Construction Report.</p> <p>Obtain documentation of DWMRC notification.</p>	<p>Within 30 days of completion of each phase of cover construction, notify the DWMRC of completion of cover construction. Provide QC with documentation of DWMRC notification. Note: The Engineering Manager, or designee, may notify the DWMRC and provide Quality Assurance documentation of the notification.</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – DRAINAGE DITCH IMPORTED BORROW

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
181) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.		
182) CLEARING AND GRUBBING: Remove vegetation, debris, organic, or deleterious material from areas to be used for borrow. Grubbing depth will depend on the type of vegetation, debris, organic, or deleterious material on the site. If the area is free of these materials then no clearing and grubbing will be necessary.	Inspect the area once clearing and grubbing has been completed. Record observations and corrective actions (where required) on the Daily Construction Report.	Verify that the clearing and grubbing has been inspected by QC.
183) MATERIAL: The imported borrow shall be classified as CL or ML soils by ASTM D-2487.	Perform laboratory classification tests at a rate of one test per lot prior to use of material in the road. A lot is defined as a maximum of 3,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the Sampling Log. a. Approve lots (which meet the specified classification) for use in the road. b. Lots not meeting the specified classification cannot be used.	Verify the frequency of laboratory tests and compliance of test results.
184) LIFT THICKNESS: Drainage ditch borrow material shall be placed in lifts with an uncompacted thickness of less than or equal to nine inches. A. Thickness for the lift will be established by installing grade poles on at least a 50-foot grid lengthwise and at all control points. The grade poles must not be installed deeper than 1 inch into the underlying clay liner. The grade poles must be marked at the appropriate depth to establish the grade. After the grade has been checked and approved by QC personnel, the grade poles shall be removed.	Verify that the required grading is achieved as follows: a. Ensure that the required frequency for placement of grade poles has been met. b. Compare soil level with the marked level on the grade poles. c. Visually check between poles for high or low spots. d. Define those areas that are high out of specification and advise the Project Manager to re-work those areas. e. Review areas re-worked and approve areas meeting criteria. f. Continue “b” through “d” above until all areas meet criteria. g. Indicate areas meeting criteria in the “Embankment	Verify the frequency of measurements and compliance of test results.

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – DRAINAGE DITCH IMPORTED BORROW

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
	Construction Lift Approval Form”.	
- OR -	- OR -	
B. Survey to determine lift thickness. Survey equipment shall have a tolerance no more than ± 0.1 foot.	<div><div>a. Verify survey equipment is within a tolerance of ± 0.1 foot.</div><div>b. Verify correct set-up and operation of equipment.</div><div>c. Visually check between survey points for high or low spots.</div><div>d. Define high out of specification areas and notify the Project Manager to rework those areas.</div><div>e. Document survey results on a survey report.</div></div>	

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - DRAINAGE DITCHES

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>185) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.</p>		
<p>186) EXCAVATION: Excavation shall be made to the lines, grades, and dimensions prescribed in the approved phase-specific plans. Temporary (operational) ditches may be constructed to these phase-specific plans. Final design grade and dimensions (as shown in the approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005) are not required to be met before final closure of the Class A West or 11e.(2) embankments.</p> <p>Prior DWMRC approval in writing must be obtained before diverting ditches from the current approved design. The purpose and duration of diversion shall be specified in any request to do so.</p> <p>Any over excavation shall be backfilled with select materials and compacted to 95 percent of standard Proctor. The uncompacted lift thickness shall not exceed nine inches.</p>	<p>Provide daily observation of the cell excavation. Record observations and corrective actions (where required) on the Daily Construction Report.</p> <p>If necessary, notify DWMRC of ditches that need to be diverted.</p> <p>In areas of over excavation, conduct in-place density test at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as a maximum of 10,000 square feet of a lift of a specified type of material. Test locations shall be chosen on the basis of random numbers (described in Specification 12).</p> <ol style="list-style-type: none"> Approve lots which meet the specified compaction. Rework and retest lots not meeting the specified compaction. <p>Proctors shall be performed at a rate of one test per 100,000 square feet for each material type. At least one proctor shall be performed for each material type. Record the location of the sample on the Sampling Log.</p>	<p>Verify daily observations and corrective actions have been documented.</p> <p>Verify that DWMRC approvals have been obtained before diverting ditches</p> <p>Verify the frequency of laboratory tests and compliance of test results.</p>
<p>187) FINAL GRADING: Smooth roll the</p>	<p>Inspect the surface for smoothness. Survey the surface</p>	<p>Review the final survey data. Verify the frequency of</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - DRAINAGE DITCHES

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
excavated surface to prepare for filter zone or riprap. Final grading of this surface shall be ± 0.1 of a foot.	on a 50 foot grid and at key points (i.e., changes in direction of the ditch). Final survey measurements will be documented on the survey report and provided to Quality Assurance.	the survey points.
188) FILTER ZONE AND ROCK EROSION BARRIER: The filter zone and rock erosion barrier shall be constructed in accordance with Specifications 164 thru 180 as appropriate.	See Specifications 164 thru 180.	See Specifications 164 thru 180.
189) EROSION CONTROL FOR EXPOSED SOIL: If reviewed and approved drainage ditch soil surfaces are not covered by filter zone or riprap within 30 days of lift approval, the following erosion control repair measures shall apply. Monthly, inspect exposed drainage ditch soil surfaces for evidence of erosion. Rivulet or gullied areas wider than six inches or deeper than six inches require maintenance to fill the rivulet or gully and restore the area to design elevation. Maintenance shall be performed within 30 calendar days when needed, unless additional time is approved by DWMRC. Erosion control blankets, mats, or fiber mulch may be used, in accordance with the manufacturer's instructions, for erosion prevention. DWMRC shall be notified at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. If used, such erosion control materials shall be removed prior to filter zone or riprap construction.	Perform monthly inspections. Document the inspection as well as associated maintenance activities on the Daily Construction Report. Obtain documentation of DWMRC notification	Review documentation to verify that monthly inspections have been performed. Notify DWMRC at least 48 hours prior to deployment of erosion control blankets, mats, or fiber mulch. Provide QC with documentation of DWMRC notification.
190) RADIOLOGICAL SAMPLING FOR	Coordinate sampling and analysis with environmental	

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - DRAINAGE DITCHES

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>EXPOSED SOIL: If reviewed and approved drainage ditch soil surfaces are not covered by filter zone or riprap within 30 days of lift approval, the area shall either</p> <p>A. be sampled and radiologically released in accordance with the Environmental Monitoring Plan; or</p> <p>B. have a minimum of six inches of ditch material removed and replaced prior to filter zone or riprap placement. Under option, no environmental sampling is required.</p>	<p>personnel. Attach a copy of the release report to the lift approval documentation.</p>	

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - INSPECTION ROAD

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE														
<p>191) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.</p>																
<p>192) MATERIAL: The material used to construct the road shall conform to the following specification:</p> <table><tr><td><u>Sieve Size</u></td><td><u>Percent Passing</u></td></tr><tr><td>1-1/2 inch</td><td>100</td></tr><tr><td>¾ inch</td><td>75-95</td></tr><tr><td>½ inch</td><td>62-82</td></tr><tr><td># 4</td><td>38-58</td></tr><tr><td># 16</td><td>16-36</td></tr><tr><td># 200</td><td>0-18</td></tr></table>	<u>Sieve Size</u>	<u>Percent Passing</u>	1-1/2 inch	100	¾ inch	75-95	½ inch	62-82	# 4	38-58	# 16	16-36	# 200	0-18	<p>Perform laboratory classification tests at a rate of one test per lot prior to use of material in the road. A lot is defined as a maximum of 3,000 cubic yards (compacted) of specified material type. Record the location of the classification sample on the Sampling Log.</p> <ul style="list-style-type: none">a. Approve lots which meet the specified classification.b. Notify the Project Manager of lots not meeting the specified classification to have the areas reworked.c. Retest lots after rework has been completed.	<p>Verify the frequency of laboratory tests and compliance of test results.</p>
<u>Sieve Size</u>	<u>Percent Passing</u>															
1-1/2 inch	100															
¾ inch	75-95															
½ inch	62-82															
# 4	38-58															
# 16	16-36															
# 200	0-18															
<p>193) SUBSURFACE PREPARATION: The subsurface will be scarified and re-compacted to at least 95 percent of a standard proctor (ASTM D698).</p>	<p>Conduct in-place density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 200 cubic yards (compacted) of material. The test location shall be chosen on the basis of random numbers (described in Specification 12).</p> <ul style="list-style-type: none">a. Approve lots which meet the specified compaction.b. Notify the Project Manager of lots not meeting the specified compaction to have the areas reworked.c. Retest lots after rework has been completed. <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 3,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the Sampling Log.</p>	<p>Verify the frequency of tests and compliance of test results.</p>														
<p>194) ROAD THICKNESS: The compacted road shall be 12 inches thick plus or minus 0.2 feet.</p>	<p>Measure the thickness of the road at both edges of the road at no greater than 50 foot intervals. Record the results on the Lift Approval Form.</p> <ul style="list-style-type: none">a. Approve lots which meet the specified thickness.b. Notify the Project Manager of lots not meeting the	<p>Verify the frequency of tests and compliance of test results.</p>														

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - INSPECTION ROAD

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>195) COMPACTION: The road will be compacted to at least 95 percent of standard Proctor (ASTM D698).</p>	<p>specified thickness to have the areas reworked.</p> <p>c. Retest lots after rework has been completed.</p> <p>Conduct in-place density tests at a rate of one test per lot and record the results on the Field Density Test form. A lot is defined as 200 cubic yards (compacted) of material. The test location shall be chosen on the basis of random numbers (described in Specification 12).</p> <p>a. Approve lots which meet the specified compaction.</p> <p>b. Notify the Project Manager of lots not meeting the specified compaction to have the areas reworked.</p> <p>c. Retest lots after rework has been completed.</p> <p>Proctors shall be performed at a rate of one test per borrow lot. A borrow lot is defined as 3,000 cubic yards (compacted) or less of a specific material type. Record the location of the Proctor sample on the Sampling Log.</p>	<p>Verify the frequency of tests and compliance of test results.</p>

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - PERMANENT CHAIN LINK FENCES

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>196) SCOPE: This work element applies to the Class A West and 11e.(2) embankments.</p>		
<p>197) MATERIALS: All burial embankments and waste storage areas, including immediately adjacent drainage structures, shall be controlled areas, surrounded by six-foot high, chain link fence. All permanent fences shall be chain link, six feet high, topped with three strand barbed wire, top tension wire and twisted selvedge.</p> <p>Zinc coated chain link fence shall meet the requirements of ASTM A392 with Class I coating. Aluminum Coated fence fabric shall meet the requirements of ASTM A491.</p> <p><u>Fence Fabric:</u> Fence fabric shall be made of 0.148 inch or larger diameter wire. The fabric shall have twisted selvedge.</p> <p><u>Wire and Ties:</u> Tension wires shall be 0.177 inch or larger diameter spiral type. Ring ties for tying fabric to supporting members shall be made of 0.148 inch or larger diameter wire. Wire ties for tying fabric to support members shall be made of 0.12 inch or larger diameter wire. Ties to line posts shall be made of 0.192 inch or larger diameter wire. All wire shall have Class II coating as specified by ASTM A116.</p> <p><u>Barbed Wire:</u> Barbed wire on zinc coated fence shall meet the requirements of ASTM A121, including a Class I zinc coating. Barbed wire shall be made of 0.099 inch or larger diameter wire with 0.080 inch or larger diameter wire four point barbs on five inch centers. When aluminum or aluminum coated fence is used, aluminum coated barbed wire</p>	<p>Obtain a copy of the manufacture's specification for the materials to be used in the construction of the fence. Verify that the materials meet the required specifications. Document materials acceptance on the Daily Construction Report.</p>	<p>Verify that the materials to be used in the construction of the fence have been approved and documented.</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - PERMANENT CHAIN LINK FENCES

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>shall be used meeting the requirements of ASTM A0491. The support arm on the fence for the barbed wire shall be capable of supporting a 200 pound vertical load at the end of the arm without permanent deflection.</p> <p><u>Posts:</u> Line posts may be "H" section or pipe. The minimum strength requirements are as follows:</p> <p>A. Load at top: 600 lbs.</p> <p>B. Maximum Moment: 1200 ft-lbs.</p> <p>C. Maximum permanent set: 0.010 in.</p> <p>"H" posts shall be coated in accordance with the requirements of ASTM A123. Pipe posts shall conform to the requirements of ASTM A120 (Schedule 40) for zinc coated pipe. All pipe posts shall be fitted with a weather resistant tip, designed to fit securely over the post, and carry an apron around the outside of the post.</p> <p><u>Fittings:</u> Fittings shall be malleable cast iron or pressed steel and be coated in accordance to ASTM A123.</p> <p><u>Gates:</u> Gate posts and frames shall be constructed of the sizes shown on the approved plans for the various gate dimensions. The corners of the gate frame shall be fastened together with pressed steel or malleable iron corner ells riveted or welded in accordance with the plans. Welded steel gate frames shall be galvanized after fabrication in accordance with the provision of ASTM A123. Chain link fence fabric for covering the gate frames shall be the same as required for the fence.</p>		

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - PERMANENT CHAIN LINK FENCES

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>Each gate shall be furnished complete with necessary galvanized hinged, latch, and drop bar locking device for the type of gate used on the project.</p>		
<p>198) INSTALLATION: The steel posts shall be set true to line and grade in concrete bases. The distances between posts shall be uniform and not exceeding 10 feet. Fence corners and ends shall be constructed in accordance with Detail A on sheet L9 of the approved engineering drawings listed in Groundwater Quality Discharge Permit UGW450005. Gates shall be constructed in accordance with Detail B on sheet L9 of the approved engineering drawings.</p>	<p>Verify that the fence is constructed in the location shown on the plans and in accordance with sheet L9. Document any problems in the Daily Construction Report.</p>	<p>Verify that the fence has been inspected and problems have been properly documented.</p>
<p>A minimum of six inches of concrete shall be provided below the bottom of each post. End posts, pull posts, corner posts, and gate posts shall have a concrete base at least 12 inches in diameter. Bases for line posts shall be at least 10 inches in diameter.</p>	<p>Spot check the depth and diameter of the post holes to verify that the holes meet the required specification. Document any problems in the Daily Construction Report.</p>	
<p>Pull posts shall be provided at 500 feet maximum intervals. Changes in line of 30 degrees or more shall be considered as corners.</p>	<p>Inspect the fence for proper placement of pull and corner posts. Document any problems in the Daily Construction Report.</p>	
<p>The fabric shall be stretched taut, and securely fastened to the posts. Fastening to end, gate, corner, and pull posts shall be with stretcher bars and metal bands, spaced at one foot intervals. The fabric shall be cut and each span fastened independently at all pull and corner posts. Fastening to line posts shall be with tie wire, metal bands, or other approved method at 14 inch intervals. The top edge of fabric shall be attached to the top rail or tension cable at approximately 24</p>	<p>Inspect the fencing fabric to verify that it has been installed in accordance with the specifications. Document any problems in the Daily Construction Report.</p>	

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT - PERMANENT CHAIN LINK FENCES

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
inch intervals. The bottom edge of the fabric should be installed within one inch of the ground surface. The bottom tension wire is required and shall be attached to the fabric with tie wires at 24 inch intervals and shall be secured to the end or pull posts with brace bands.		

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – SETTLEMENT MONITORING

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>199) SCOPE: This work element applies to the LARW, Class A West, 11e.(2), and Mixed Waste embankments.</p> <p>200) SETTLEMENT MONUMENTS: Settlement monuments constructed before January 1, 2005 consist of #4 or greater rebar that is approximately three feet long, secured in place using a sand-cement grout. Grout shall consist of approximately 1/2 cubic foot of low slump fiber reinforced grout per monument. The top of the rebar shall be placed roughly even with the top of the riprap rock. Each monument shall be permanently labeled, flagged, and documented on a reference drawing.</p> <p>Settlement monuments constructed after January 1, 2005 shall consist of approximately four-foot long #5 or greater rebar that is welded to a metal plate. The metal plate shall be approximately 18 inches square with a thickness of 3/16 inch to 1/4 inch. The rebar shall be sized to extend no more than six inches above the rock erosion barrier surface. The settlement plate shall be placed on top of the final approved radon barrier (Class A and LARW cells) or on top of the final approved geosynthetics layer (Mixed Waste) and then secured by the rock cover layers as they are built. Each monument shall be permanently labeled, flagged, and documented on a reference drawing.</p>		
	<p>Inspect settlement monuments for compliance with the specification prior to installation. Observe installation to ensure that the radon barrier or geosynthetic layer is not damaged.</p>	<p>Perform a surveillance of monument installation activities.</p>
<p>201) SETTLEMENT MONUMENT PLACEMENT: Settlement monuments constructed prior to January 1, 2005 are set at 100- and 200-foot grids, as indicated on Figure 1.</p> <p>Settlement monuments constructed after January 1,</p>	<p>Perform and document a post-construction survey of</p>	<p>Verify that surveys have been performed and</p>

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – SETTLEMENT MONITORING

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
2005 on the LARW, Class A West, Mixed Waste, and 11e.(2) embankments shall be placed at the locations identified on Figures 1, 2, 3, and 4, respectively.	the placed settlement monument.	documented.
202) SURVEY REQUIREMENTS: Surveys shall be performed with GPS or approved equivalent equipment. Tolerance shall be no more than ± 0.1 feet.	Calibrate and operate survey equipment in accordance with the manufacturer's recommendations	
203) SURVEY INTERVAL: Settlement monuments constructed before January 1, 2005 shall be surveyed prior to grouting and again afterwards within 30 days of grouting for coordinate verification. Annual surveys of the existing monuments shall continue for a minimum of five years from the date of grouting. In cases where monuments are reset, measurements shall continue at the specified frequency continuing from the last reliable measurement. Weather conditions at the time of the survey and a discussion of the potential for frost to be present shall be documented in the survey report.	Perform and document the required surveys in a survey report. Provide survey data to the Engineering Manager.	Verify that monument surveys are completed and documented as required.
Settlement monuments constructed after January 1, 2005 shall be set and surveyed for initial location within 30 days of the completion of final cover construction. New monuments shall be surveyed again at 2, 4, and 12 months (± 10 calendar days) after the initial survey. Thereafter, monuments shall be surveyed once annually between October 1 and December 31 until a minimum of five years after initial placement. Weather conditions at the time of the survey and a discussion of the potential for frost to be present shall be documented in the survey report.	Perform and document the required surveys in a survey report. Provide survey data to the Engineering Manager.	Verify that new monument surveys are completed and documented as required.

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – SETTLEMENT MONITORING

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
<p>During the annual survey, perform a visual inspection of the completed cover to evaluate potential areas of settlement that may not be captured by the settlement monument network.</p> <p>204) REPORTING: Settlement monitoring data shall be summarized and evaluated in the annual as-built report for each embankment.</p> <p>Calculate total and differential settlement for each settlement monument against the most recent measurement and against the baseline monument location.</p> <p>Total settlement of more than 1.5 feet at any settlement monument or differential settlement of more than 1.0 percent slope between adjacent monuments shall be reported to and evaluated by the Engineering Manager within 30 days of measurement and discussed in the annual as-built report.</p> <p>Any failure in the settlement monuments shall be documented. A replacement monument shall be reset as close as possible to the previous location, surveyed, and documented.</p>	<p>Document observations made during the inspection, and denote areas where differential settlement may be occurring. Provide documentation to the Engineering Manager.</p> <p>Provide settlement monitoring data to the Engineering Manager.</p>	<p>Perform a surveillance of visual inspection activities.</p>

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TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – ANNUAL AS-BUILT REPORT

SPECIFICATION	QUALITY CONTROL	QUALITY ASSURANCE
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205) SCOPE: This work element applies to the LARW, Class A West, and 11e.(2) embankments.		
206) AERIAL SURVEY REQUIREMENTS: An aerial survey of all areas within 100 feet of Section 32 shall be performed between August 15 and September 15 each year. The aerial survey shall be performed by a registered land surveyor. Survey control points shall be identified in the survey report. Survey tolerance shall not exceed ± 0.75 ft. Actual tolerance of the survey shall be stated in the report.		
207) ANNUAL AS-BUILT VOLUMES: Calculate embankment volumes from the aerial survey data using AutoCAD or approved equivalent equipment. As required in I.H.6 of Groundwater Quality Discharge Permit UGW450005, provide plan view and cross-sections of the as-built embankment based on the aerial survey data. Include in each cross-section the profile of the maximum authorized waste elevation. Also include in each cross-section the elevation profile of the top of the uppermost approved waste lift (as of the time the lift was approved). Provide a clear key to each cross-section to define the meaning of each symbol and line used. For each embankment, report the design capacity, capacity used to date, and remaining capacity,		

LLRW and 11e.(2) CQA/QC MANUAL
TABLE 1 - QA/QC ACTIVITIES
WORK ELEMENT – ANNUAL AS-BUILT REPORT

SPECIFICATION

QUALITY CONTROL

QUALITY ASSURANCE

including overburden. Compare remaining capacity with the surety reserve capacity for each embankment. Report any volume of waste that is placed over the design top of waste.

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TABLE 2

MATERIAL SPECIFICATIONS FOR PORTLAND CEMENT CLSM

PROPERTY	TEST METHOD	MINIMUM	MAXIMUM	FREQUENCY										
WET UNIT WEIGHT	ASTM D6023	100 lbs/ft ³	None	One Test/2,000 Cubic Yards/Lift										
SLUMP	EnergySolutions Slump Test (Appendix B)	Eight inches	None	One Test/100 Cubic Yards/Lift										
-OR- FLOW	EnergySolutions Efflux Test (Appendix B)	NA	26 seconds	One Test/100 Cubic Yards/Lift										
-OR- FLOW CONSISTENCY	Flow Consistency (ASTM D6103)	Eight inches	None	One Test/100 Cubic Yards/Lift										
28 DAY COMPRESSIVE STRENGTH	ASTM D4832	150 psi	None	One Test/2,000 Cubic Yards Placed at 28 days										
CEMENT	None	50 lbs for each cubic yard of CLSM	None	Inspect each load ticket prior to pour										
POZZOLAN	None	None	375 lbs for each cubic yard of CLSM	Inspect each load ticket prior to pour										
AGGREGATE SIZE	Gradation Test Certificate from Batch Plant ASTM C117 ASTM C136	<table><tr><td><u>Percent Passing</u></td><td><u>Sieve</u></td></tr><tr><td>100</td><td>3/8"</td></tr><tr><td>60</td><td>#8</td></tr></table>	<u>Percent Passing</u>	<u>Sieve</u>	100	3/8"	60	#8	<table><tr><td><u>Percent Passing</u></td><td><u>Sieve</u></td></tr><tr><td>30</td><td>200</td></tr></table>	<u>Percent Passing</u>	<u>Sieve</u>	30	200	One certification per day if material is received from exterior batch plant or One test per stockpile if material is received from onsite batch plant. Gradation certificate shall be received by QC Technician prior to pouring any CLSM
<u>Percent Passing</u>	<u>Sieve</u>													
100	3/8"													
60	#8													
<u>Percent Passing</u>	<u>Sieve</u>													
30	200													